Research Article

Acute Complications Associated With Haemodialysis in a CKD Cohort Population

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ABSTRACT

Background: Chronic kidney disease is becoming a major public health problem worldwide. The expansion of haemodialysis into a chronic renal replacement therapy also created a new field of medical science, sometimes termed the physiology of the artificial kidney but associated with acute complications. **Objectives:** The current longitudinal cohort study of six months duration was performed in a tertiary care teaching hospital of south India to assess acute complications associated with haemodialysis in a CKD cohort. **Materials and Methods:** A Structured process was followed for obtaining permission from hospital authority after the acceptance of institutional review board, a total of 109 patients diagnosed with CKD of both the genders attending department of nephrology for haemodialysis showing willingness towards the study were included and others were excluded. Enrolled patient's demography, approximate data of diagnosis (old cases) and definite data of diagnosis (new cases), vital parameters, treatment, physical examinations and laboratory parameters were obtained and documented. **Results:** In our study of 109 CKD patients, 81.65% were male and 49.53% falls under the age group of 41 – 60 years, it was observed that 56.88% patients suffers severe anaemia out of which 43.12% were female, and 51.37% suffered severe chronic kidney disease based on serum creatinine levels. Stage I hypertension was reported in 36.69% of patients. **Conclusion:** In conclusion, complications caused by the reasons other than the dialysis machine and water system remain as a significant cause of morbidity and mortality in haemodialysis patients.

Key words: Acute complications, end stage renal disease, haemodialysis, serum creatinine level, cohort study.

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INTRODUCTION

Chronic kidney disease (CKD) is recognized as a major health problem affecting approximately 13% of the United States population.[1] Numbers of prevalent CKD patients will continue to rise, reflecting the growing elderly population and increasing numbers of patients with diabetes and hypertension.

In western countries, diabetes and hypertension account for over 2/3rd of the cases of CKD.[2] In India too, diabetes and hypertension today account for 40–60% cases of CKD.[3] As per recent

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Indian Council of Medical Research data, prevalence of diabetes in Indian adult population has risen to 7.1%, (varying from 5.8% in Jharkhand to 13.5% in Chandigarh) and in urban population (over the age of 40 years) the prevalence is as high as 28%.[4,5] Likewise the reported prevalence of hypertension in the adult population today is 17% (14.8% from rural and 21.4% from urban belt). A similar prevalence of 17.4% has been reported by Panesar *et al.* (in the age group of 20–59 years) even from slum-resettlement colony of Delhi.[6,7] With rising prevalence of these diseases in India, prevalence of CKD is expected to rise, and obviously this is the key target population to address.

In the 20th century, the development and implementation of dialysis as a life-sustaining therapy for kidney failure constituted a "magical" medical advance. The expansion of haemodialysis into a chronic renal replacement therapy also created a new field of medical science, sometimes termed the physiology of the artificial kidney.[8] When the National Cooperative Dialysis Study (NCDS), the first landmark randomized trial in dialysis, demonstrated that a higher dose of delivered dialysis (measured as the time-averaged plasma concentration of urea) was associated with a lower risk for subsequent hospitalization,[9] a science of dialysis had emerged.[10] Gotch and Sargent[11] used NCDS data to develop the concept of Kt/Vurea, a dimensionless construct that relates the clearance of urea to its volume of distribution, as a measure of dialysis dose.

Nephrologists became familiar with concepts of diffusive and convective clearance, volume of distribution, and solute modelling. Quantifying the dialysis prescription became part of the parlance of clinical nephrology, thereby objectifying the "magical" early results with dialysis therapy.[8]

In the absence of this therapy, more than a million patients worldwide would have died within weeks. Haemodialysis was successfully performed for the first time in 1944 by Willem Kollf in patients with renal failure. However, haemodialysis is accompanied by several complications. During the first years following the introduction of haemodialysis, complications were common due to the technical drawbacks associated with the dialysis machines and water systems.[12]

Currently, the advances in technology, particularly those in the last 20 years, have reduced the complications. However, complications caused by the reasons other than the dialysis machine and water system remain as a significant cause of morbidity and mortality in haemodialysis patients.[12]

Unfortunately, from India there are no literatures and limited data on the acute complications due to haemodialysis in CKD patients. Hence, we performed the current study to assess acute complications associated with haemodialysis in a CKD cohort population.

MATERIALS AND METHODS

The current longitudinal cohort study of six months duration was performed in department of nephrology of a tertiary care teaching hospital of south India. A Structured process was followed for obtaining permission from hospital authority by submitting a detailed profoma of the study which includes protocol of study, evidence of critically evaluated biomedical literatures, data collection form, patient informed consent form. After the initial acceptance from the hospital, study was registered in the institutional review board (IRB) of the institution for ethical approval (RIPER/IRB/2016/002).

A total of 109 patients diagnosed with CKD of both the genders attending the department of nephrology for haemodialysis showing willingness towards the study were included and others were excluded (patients who showed unwillingness and with other organ failure). A documentation from (data collection form) was designed to collect the patient's information which was kept confidential, the information from patients were collected only after explaining the merits and demerits of the study and obtaining their consent for which an informed consent form was designed separately.

After enrolling the patients in to study; demography, approximate data of diagnosis (old cases) and definite data of diagnosis (new cases), vital parameters, treatment, physical examinations and laboratory parameters (for assessing the severity of complications based on clinical manifestations and abnormal objective data's), were obtained and documented.

RESULTS

The study was based on assessing the acute complications of haemodialysis in 109 CKD patients, who are regularly visiting the department of nephrology in a tertiary care teaching hospital of south India.

Demographic details of study participants

In our study of 109 CKD patients, 81.65% were male and 49.53% falls under the age group of 41 – 60

Table 1: Demographic details of the study participants.

S no	Age group	Female		Male (%)		Total (%)	
		N	%	N	%	N	%
1	< 20 Years	0	0	5	4.58	5	4.58
2	21 – 40 Years	4	3.67	28	25.69	32	29.35
3	41 – 60 Years	16	14.67	38	34.86	54	49.54
4	60 – 80 Years	00	00	18	16.51	18	16.54
	Total	20	18.34	89	81.65	109	100

years collectively, results of which are summarized in Table 1. Demographic details of the study participants.

Frequency distribution of anaemic patients

On performing the haematological function test based on the level of haemoglobin, it was observed that 56.88% patients suffers severe anaemia out of which 43.12% were female, results of which are summarized in Table 2. Frequency distribution of Anaemic patients.

Frequency distribution of CKD based on serum

Table 2: Frequency distribution of anaemic patients.

S no	Types of Anemia	Corresponding Hg levels (g/dl)		Male		Female		Total	
				N	%	N	%	N	%
1	Mild	Male	11 – 12.9	5	4.58	0	0	5	4.58
		Female	11 – 11.9						
2	Moderate	Male	8-10.9	37	33.94	5	4.58	42	38.53
		Female	8-10.9						
3	Severe	Male	< 8	47	43.12	15	13.76	62	56.88
		Female	< 8						
		Total		89	81.65	20	18.34	109	100

Table 3: Frequency distribution of CKD based on serum creatinine levels (Gender wise)

S no	CKD Stage based on serum creatinine levels (µmol/L)	Male		Female		Total	
		N	%	N	%	N	%
1	Mild (150-300)	0	0	0	0	0	0
2	Moderate (300-700)	40	36.69	13	11.92	53	48.61
3	Severe (> 700)	49	44.95	7	6.42	56	51.37

Table 4: Frequency distribution of CKD based on serum creatinine levels (Age wise).

S no	Age Group (in years)	Mild CKD		Moderate CKD		Severe CKD	
		N	%	N	%	N	%
1	< 20	0	0	2	1.83	3	2.75
2	21-40	0	0	13	11.92	19	17.43
3	41-60	0	0	30	27.52	24	22.01
4	61-80	0	0	8	7.34	10	9.17
	Total	0	0	53	48.62	56	51.37

Table 5: Frequency distribution of Hypertension among CKD patients.

S no	Stage of Hypertension	Male		Female	
		N	%	N	%
1	Normal	9	8.25	3	2.75
2	Pre-hypertension	15	13.76	3	2.75
3	Stage-1	35	32.11	5	4.58
4	Stage-2	30	27.52	9	8.25
	Total	89	81.65	20	18.34

Table 6. Distribution of complications associated with CKD (age and gender wise).

Complications	Age group							
	< 20 Years		21 – 40 Years		41 – 60 Years		61 – 80 Years	
	Male	Female	Male	Female	Male	Female	Male	Female
Headache	4	0	23	2	32	14	15	0
Muscle cramps	2	0	27	2	37	12	17	0
Nausea and vomiting	4	0	18	3	28	6	14	0
Febrile reactions	3	0	20	2	29	7	15	0
Hypotension	2	0	16	4	30	9	17	0
Hypertension	0	0	21	3	32	11	12	0
Disequilibrium syndrome	2	0	17	2	23	9	11	0
Hemodialysis related infections	0	0	12	2	15	7	14	0
Thrombocytopenia	0	0	15	3	20	10	17	0

creatinine levels

The level of serum creatinine in our study participants reported that 51.37% suffered severe CKD (serum creatinine > 700 μmol/L), out of which 22.01% falls under the age group of 41 – 60 years; results of which are summarized in Table 3. Frequency distribution of CKD based on serum creatinine levels (gender wise) / Table 4. Frequency distribution of CKD based on serum creatinine levels (age wise).

Frequency distribution of Hypertension among CKD patients

The blood pressure monitored in our CKD cohort reported that 36.69% suffers stage I hypertension, in which 32.11% were male; and 8.25% of female suffers stage II hypertension, results of which are summarized in Table 5. Frequency distribution of Hypertension among CKD patients.

Distribution of complications associated with CKD (age and gender wise)

In our study, the age group of 41 – 60 years with male were at higher risk of CKD associated complications based on clinical manifestations, physical examination and subjective data's; results of which are summarized in Table 6. Distribution of complications associated with CKD (Age and Gender wise).

DISCUSSION

Chronic kidney disease (CKD) is becoming a major public health problem worldwide. The current burden of disease might due to a change of the underlying pathogenicity of CKD. Given the pathogenic progression of kidney disease, patients with CKD are at high risk for progression to the end stage renal disease (ESRD) – a condition requiring dialysis or kidney transplantation to maintain patients' long-term survival.[13]

In addition, CKD has a complicated interrelationship with other diseases.[14] Recent studies have reported that CKD is an independent risk factor for cardiovascular disease (CVD).[15] Therefore, kidney dysfunction should be an additional target for intervention and prevention of CVD.[16] In 2003, the American Heart Association (AHA) stated that persons with CKD should be regarded as the highest risk group for subsequent CVD.[17] Although haemodialysis is a lifesaving and relatively safe, several complications may still arise. Some are inherent side effects of the normal extra corporeal circuit; some results from technical errors, and yet others are due to abnormal reactions of patients to the procedure.[18]

In our study of 109 CKD cohort, prevalence was found higher in men (81.65%) in comparison to female, gender differences have been documented in the field of nephrology. Women seem to be somewhat protected from developing ESRD.[19] The cumulative incidence of ESRD remains low during the reproductive ages and begins to rise 10 years later in women than in men among participants in community-based screenings.[19] A nationwide survey of ESRD by the Japanese Society for Dialysis Therapy revealed a higher incidence and prevalence in men than in women.[20]

Anaemia commonly occurs in people with chronic kidney disease (CKD)—the permanent, partial loss of kidney functions. Anaemia might begin to develop in the early stages of CKD, when someone has 20 to 50 percent of normal kidney function. Anaemia

tends to worsen as CKD progresses. Most people, who have total loss of kidney function, or kidney failure, have anemia.[21] In our study, 56.88% patients suffers severe anaemia out of which 43.12% were female, Similar findings were observed in Gazmend *et al*.[22]

The appropriate use of serum creatinine level as a surrogate for time in the course of renal failure when dialysis commences requires it to be a significant predictor of mortality in incident patients with end-stage renal disease (ESRD). Creatinine values from an incident ESRD population have a weak relationship with the timing of dialysis initiation but represent a strong measure of health status.[23] The level of serum creatinine in our study participants revealed that 51.37% suffered severe CKD (serum creatinine $> 700\ \mu$mol/L), out of which 22.01% falls under the age group of 41 – 60 years.

Cardiovascular diseases accounts for approximately 45% of the causes of mortality in dialysis patients (Shastri and Sarnak, 2010).[24] Hypertension (HT) is the most frequently observed complication in chronic haemodialysis patients. Over 80% of the patients have HT histories and the blood pressures of two thirds of these are not under control.[12] The blood pressure monitored in our CKD cohort reported that 36.69% suffers stage I hypertension, in which 32.11% were male; and 8.25% of female suffers stage II hypertension. As a result of many observational studies, it was shown that low blood pressure (BP) increased mortality; the lowest mortality was in those with a pre-dialysis blood pressure between 140-160/70-90 mmHg and the highest mortality was in those patients with > 180/100 mmHg (Agarwal,[25] Lacson and Lazarus,[26] Peixoto and Santos).[27]

Neurologic complications may develop in the patients of end-stage renal failure due to a multiple metabolic disorder caused by a chronic kidney disease and due to the dialysis procedure. These complications may appear in the form of variations in consciousness, headache, nausea, vomiting, myoclonus, tremor, focal and generalized seizures, cerebrovascular events (infarct and bleeding) and disequilibrium syndrome.[12]

The International Headache Society (ICHD, 2004) included the haemodialysis headache in the headache classification. To be able to mention a haemodialysis headache, the headache should prevail in at least half of the haemodialysis sessions, there should be 3 acute headache attacks meeting at least two criteria and the headache should be relieved within 72 h after the haemodialysis (Gladstone and Dodick,[28] Goksel *et al*).[29] Although its prevalence is not certain, it was found to be 30% by Goksel *et al*[29] and 48% by Goksan *et al*.[30] Jesus AC *et al*[31] on the other hand, found a much lower prevalence of 6.7% in 2009 our study reported 82.57% of headache in CKD cohort.

Our study showed the following distribution of complications associated with haemodialysis: muscle cramps (89%), hypotension (71.56%), febrile reactions (69.72%), nausea and vomiting (66.97%), thrombocytopenia (59.63%), disequilibrium dysfunction (58.72%), and haemodialysis related infections (45.87%), these observations were higher in comparison to the study performed by Rashid AS.[32]

CONCLUSION

In conclusion, the incidence of ESRD is increasing worldwide despite several strategies, including universal or targeted screening and new drugs. Haemodialysis, which is one of the renal replacement therapies, is a life-saving treatment. However, it is accompanied by several complications. Currently, the advances in technology, particularly those in the last 20 years, have reduced the complications, but complications caused by the reasons other than the dialysis machine and water system remain as a significant cause of morbidity and mortality in haemodialysis patients.

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CONFLICT OF INTEREST

The author declares no Conflict of Interest.

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Nil

ABBREVIATIONS

CKD: Chronic Kidney Disease;ICMR :Indian Council of Medical Research; NCDS : National Cooperative Dialysis Study; RIPER: Raghavendra Institute of Pharmaceutical Education and Research; IRB: Institutional Review Board; ESRD: End Stage

Renal Disease; CVD :Cardio Vascular Disease; AHA: American Heart Association; JSDT: Japanese Society for Dialysis Therapy; HT: Hypertension; BP: Blood Pressure; ICHD: International Headache Society.

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