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Frequency of Intradialytic Complications among Patients of Maintenance Hemodialysis on Thrice Weekly

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ABSTRACT

Renal replacement therapy for ESRD includes hemodialysis, peritoneal dialysis, and transplantation, with hemodialysis being the most common. Over two million patients receive it annually. ESRD patients often have comorbidities like heart disease, vascular disease, and COPD, increasing their health risks. **Objectives:** To determine the frequency of intra-dialytic complications occurring in patients on maintenance hemodialysis. **Methods:** This cross-sectional study was conducted at the Nephrology Department of Sir Ganga Ram Hospital, Lahore. A total of 83 ESRD patients aged 15–70 years, undergoing thrice-weekly hemodialysis, were selected using non-probability consecutive sampling. Patients with acute renal failure, dementia, or unconsciousness were excluded. Dialysis was performed using Fresenius, Surdial, Toray, and Nipro machines, with complications monitored over two months. Data were recorded using a structured proforma and analyzed with SPSS version 25.0, with qualitative variables presented as frequencies and percentages and continuous variables as mean ± SD. Chi-square tests were applied, with statistical significance set at p≤0.05. **Results:** Among 83 patients (63.9% male, 63.9% >40 years), 60.2% had CKD for <5 years. Diabetes (65) and hypertension (29) were the leading causes. The most common complications were hypotension (28), nausea/vomiting (17), and cramping (11). There was no significant association among complications of CKD with age, gender, duration of disease and type of hemodialysis (p-value>0.05). **Conclusions:** Dialysis complications are common, with hypotension being the most frequent, followed by nausea, vomiting, hypertension, and muscle cramps. Diabetic patients are more vulnerable, emphasizing the need for better monitoring and preventive strategies to improve outcomes.

INTRODUCTION

The global prevalence of kidney diseases has risen to 11–13% over the past two decades, primarily due to the increasing burden of diabetes mellitus (DM), the leading cause worldwide. Other contributing factors include hypertension, glomerular diseases, renal stones, and excessive use of over-the-counter medications. End-stage renal disease (ESRD) is managed through renal replacement therapy (RRT), including dialysis hemodialysis or peritoneal dialysis and renal transplantation. Hemodialysis, a widely used treatment, enrolls over two million patients annually [1, 2]. Hemodialysis, crucial for end-stage renal disease, typically lasts 3–4 hours per session, conducted thrice weekly in developed countries and twice weekly in developing nations. Patients, often with comorbidities like ischemic heart disease, peripheral vascular disease, cerebrovascular disease, and COPD, face higher morbidity and mortality risks [3]. Despite its life-saving benefits, hemodialysis is generally safe, with a mortality rate of 1 in 75,000 treatments. However, complications arise, categorized as acute (occurring during or immediately after treatment) or chronic [4]. Hemodialysis complications arise from various factors related to equipment and patient conditions. Key factors include dialyzer type, conductivity, blood flow, ultrafiltration rate, anticoagulant use, and water contamination. Advances in technology have reduced

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these risks. Patient-related contributors include underlying disease, comorbidities, medications, weight gain during dialysis, and treatment frequency and duration [5, 6]. Hypotension, which is characterized by a decline in systolic blood pressure (SBP) greater than 20 mm Hg or a reduction in mean arterial pressure by 10 mmHg, stands as the most prevalent acute complication globally, with a reported incidence ranging from 25% to 55%. The National Kidney Foundation-Kidney Disease Outcomes Quality Initiative provides this definition. Additional complications encompass arrhythmias at a rate of 50%, while nausea and vomiting during and after the session occur in 15% of cases. Muscle cramps afflict 20% of individuals, followed by less frequent occurrences of headache, chest pain, back pain at 5%, and hypertension, fever, and chills due to dialyzer reaction [7, 8]. In a research endeavor, it was determined that hypotension emerged as the prevailing complication, accounting for 28.7% of cases, with nausea/vomiting following closely behind at 11.75%. Fever and muscle cramps were also observed as prominent symptoms, each representing 8.5% of occurrences [9]. The occurrence of end-stage renal disease (ESRD) in Pakistan amounts to 14.6%. In addition, given the escalating occurrence of chronic ailments, which are eventually associated with ESRD, it is imperative to assess the advantages and disadvantages of the available methods for managing this condition [10].

The primary objective of this investigation was to ascertain the diverse complications that frequently arise in the course of hemodialysis to facilitate the identification and implementation of preventive measures. This endeavor augments the understanding of hemodialysis complications among healthcare personnel and patients alike, aiding them in making informed decisions regarding treatment options. This study aimed to determine the frequency of intra-dialytic complications occurring in patients on maintenance hemodialysis at Sir Ganga Ram Hospital, Lahore.

METHODS

This cross-sectional study was conducted at the Nephrology Department of Sir Ganga Ram Hospital, Lahore, from July to December 2024, following synopsis approval (No:159-MD/ERC). A total of 83 participants were selected using non-probability consecutive sampling, based on a 95% confidence level, a 6% margin of error, and an estimated muscle cramp prevalence of 8.5% [7]. Patients aged 15 to 70 years with end-stage renal disease (ESRD), undergoing thrice-weekly acute hemodialysis, regardless of comorbidities or dialysis access site, were included. End-stage renal disease (ESRD) was defined as patients with a GFR <15 mL/min/1.73m^2 requiring hemodialysis initiation. Patients receiving hemodialysis due to acute renal failure or those with dementia or unconsciousness were excluded. Ethical approval was obtained before recruitment, and all use past tense participants were provided written informed consent. Demographic data (age, gender), cause of CKD, comorbidities, and baseline blood pressure were obtained from hospital medical records and verified with patients during interviews. Pre- and post-dialysis blood pressure values were recorded directly from dialysis session monitoring sheets maintained by nursing staff. The study population consisted of patients with a permanent vascular access (AV fistula), undergoing dialysis using a Fresenius hemodialysis machine. Dialysis-related complications were monitored over two months, with data recorded using a structured proforma. Statistical analysis was performed using SPSS version 25.0. Qualitative variables such as gender, ESRD cause, and type of hemodialysis were presented as frequencies and percentages, while continuous variables such as age and dialysis duration were expressed as mean ± standard deviation. Data were stratified by gender, age, type of hemodialysis, and dialysis duration to account for effect modifiers. Chi-square tests were applied for categorical variables, with statistical significance set at $p \leq 0.05$.

RESULTS

The study included 83 patients, with a majority (63.9%) being over the age of 40 years, while 36.1% were younger than 40 years. In terms of gender distribution, 63.9% of the patients were male, and 36.1% were female. The duration of disease varied, with 60.2% of patients having the condition for less than 5 years, while 39.8% had been affected for more than 5 years (Table 1).

Table 1: Demographic Features of Patients

Variables	Frequency (%)
Age	
<40	30 (36.1%)
>40	53 (63.9%)
Gender	
Male	53 (63.9%)
Female	30 (36.1%)
Duration of Disease	
<5 Years	50 (60.2%)
>5 Years	33 (39.8%)

The most common causes of CKD among patients were diabetes mellitus, affecting 65 individuals, followed by hypertension, which was present in 29 patients. Other notable causes included obstructive nephropathy (17 patients) and polycystic kidney disease (PKD) (13 patients). Conditions such as glomerulonephritis and chronic pyelonephritis were observed in 10 patients each, while congenital or hereditary disorders were reported in 9

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patients. Myeloma was the least common cause, affecting only 4 patients (Figure 1).

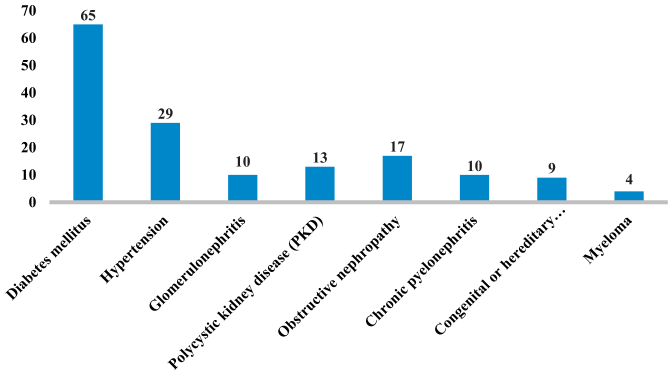

Figure 1: Causes of CKD among Patients

Complications varied among patients based on gender, age, and type of hemodialysis. Hypotension was the most frequently reported complication, occurring in 16 female and 12 male. Other common complications among male included nausea and vomiting (11 cases) and cramping (9 cases), while among female, hypotension (16 cases) was the most prominent issue (p-value=0.07). When analyzed by age groups, patients older than 40 years experienced a higher frequency of hypotension (20 cases) and nausea and vomiting (10 cases) compared to younger patients (8 and 7 cases, respectively) (p-value=0.615). Other complications were relatively evenly distributed between the two groups (p-value=0.90) (Table 2).

Table 2: Complications among Patients Based on Gender, Age, and Type of Hemodialysis

Variables	Hypotension	Cramping	Nausea/Vomiting	Backache	Chest Pain	Itching	Headache	Fever	p-Value
Gender									
Male (n=53)	12 (22.6%)	9 (17.0%)	11 (20.8%)	7 (13.2%)	4 (7.5%)	6 (11.3%)	3 (5.7%)	1 (1.9%)	0.070
Female (n=30)	16 (53.3%)	2 (6.7%)	6 (20.0%)	2 (6.7%)	3 (10.0%)	0 (0.0%)	0 (0.0%)	1 (3.3%)	
Age									
<40 Years (n=40)	8 (20.0%)	4 (10.0%)	7 (17.5%)	3 (7.5%)	5 (12.5%)	2 (5.0%)	1 (2.5%)	0 (0.0%)	0.615
≥40 Years (n=43)	20 (46.5%)	7 (16.3%)	10 (23.3%)	6 (14.0%)	2 (4.7%)	4 (9.3%)	2 (4.7%)	2 (4.7%)	
Duration of Disease									
<5 Years (n=48)	13 (27.1%)	4 (8.3%)	7 (14.6%)	3 (6.3%)	3 (6.3%)	2 (4.2%)	0 (0.0%)	1 (2.1%)	0.914
≥5 Years (n=35)	15 (42.9%)	7 (20.0%)	10 (28.6%)	6 (17.1%)	4 (11.4%)	4 (11.4%)	3 (8.6%)	1 (2.9%)	

The distribution of blood pressure status was evaluated across three time points (pre- and post) in a sample of 83 participants. At baseline (pre_BP_1), 44.6% of participants were hypertensive (HTN) and 55.4% had normal blood pressure. Following the first intervention (post_BP_1), the proportion of hypertensive individuals increased to 50.6%, while those with normal blood pressure decreased to 49.4%. A similar distribution was observed in pre_BP2, with 50.6% hypertensive and 49.4% normal. However, in post_BP2, the proportion of hypertensive participants rose further to 59.0%, while normal readings dropped to 39.8%, and a small number (1.2%) were classified as having low blood pressure. In pre_BP3, hypertension was highest at 68.7%, with only 31.3% having normal readings. This percentage improved slightly in post_BP3, where 55.4% remained hypertensive and 44.6% had normal blood pressure (Table 3).

Table 3: Blood Pressure Status Across Time Points

Category	Pre_BP_1	Post_BP_1	Pre_BP2	Post_BP2	Pre_BP3	Post_BP3
HTN	37 (44.6%)	42 (50.6%)	42 (50.6%)	49 (59.0%)	57 (68.7%)	46 (55.4%)
NORMAL	46 (55.4%)	41 (49.4%)	41 (49.4%)	33 (39.8%)	26 (31.3%)	37 (44.6%)
LOW	–	–	–	1 (1.2%)	–	–
Total	83 (100%)	83 (100%)	83 (100%)	83 (100%)	83 (100%)	83 (100%)

Descriptive statistics for participants' weight across three time points revealed slight changes before and after each dialysis session. The mean pre-dialysis weight at the first time point was 61.67 kg, which increased to 65.87 kg post-dialysis. The second pre-dialysis weight showed a mean of 69.36 kg, while the post-dialysis mean was 59.69 kg. At the third time point, the mean pre-dialysis weight was 61.34 kg, with the post-dialysis mean again at 59.69 kg. Overall, the data indicate a modest reduction in weight following dialysis sessions, although some inconsistencies suggest the need for further data verification (Table 4).

Table 4: Pre and Post Weight after Each Dialysis Session

Time Point	Mean ± SD
Before First Dialysis Session (Pre-Weight 1)	61.6 ± 74.0
After First Dialysis Session (Post-Weight 1)	65.86 ± 56.98
Before Second Dialysis Session (Pre-Weight 2)	69.36 ± 67.68
After Second Dialysis Session (Post-Weight 2)	59.69 ± 4.031
Before Third Dialysis Session (Pre-Weight 3)	61.34 ± 7.40
After Third Dialysis Session (Post-Weight 3)	59.69 ± 3.98

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DISCUSSION

Renal replacement therapy (RRT) for end-stage renal disease (ESRD) includes hemodialysis, peritoneal dialysis, and renal transplantation. Hemodialysis is one of the most widely used treatments, with over two million patients receiving it annually [11]. ESRD patients often have comorbidities such as ischemic heart disease, peripheral vascular disease, cerebrovascular disease, and COPD, which heighten their morbidity and mortality risks [12]. Although hemodialysis is a life-saving and generally safe procedure, it is associated with acute complications that may arise during or immediately after sessions, as well as chronic complications over time. Therefore, the present study was conducted to determine the frequency of intradialytic complications occurring in patients on maintenance hemodialysis. This study included 83 patients, with 63.9% aged over 40 years and 63.9% male. Most (60.2%) had the condition for less than 5 years. A majority (68.7%) received bicarbonate-based hemodialysis. These findings were comparable with another study, which reported that among the 280 patients, 184 (65.7%) were male, indicating a predominance of men in the study population. The mean age was 47.9 ± 17.5 years, reflecting a broad age range. Overall, a male preponderance (69.1%) was observed, suggesting that men were more commonly affected by conditions necessitating dialysis [13]. The male predominance in our study aligns with previous findings, largely influenced by socioeconomic and cultural barriers that limit women's access to healthcare and result in skewed referral patterns [14]. Additionally, biological differences may contribute, as testosterone induces apoptosis in renal tubules, accelerating CKD progression in men, while estrogens offer renal protection, potentially delaying disease progression in women [15]. These factors collectively explain the higher prevalence of end-stage renal disease (ESRD) and dialysis dependence among men [16, 17]. In the current study, the leading causes of CKD were diabetes mellitus (65 patients) and hypertension (29 patients), followed by obstructive nephropathy (17) and PKD (13). Literature reports that CKD risk factors, categorized as initiating or perpetuating, include genetics, ethnicity, socioeconomic status, and age. The leading cause is diabetes mellitus, followed by glomerulonephritis, genetic disorders, medications, cardiovascular and multisystem diseases, urinary tract obstruction, infections, and AKI [18]. Studies have identified various CKD risk factors, including age, sex, ethnicity, family history, and socioeconomic status. Metabolic syndrome, dyslipidemia, and urinary albumin excretion contribute to disease progression, while nephrotoxins (NSAIDs, antibiotics, contrast agents) and primary kidney diseases (glomerulonephritis, PKD) increase susceptibility. Urinary disorders (obstruction, recurrent UTIs) and cardiovascular diseases further elevate risk. Diabetes mellitus remains the leading cause, and acute kidney disorders (AKD) can progress to CKD if untreated [19, 20]. In the current study, the reported complications included hypotension (28 cases), nausea and vomiting (17 cases), cramping (11 cases), backache (9 cases), chest pain (7 cases), itching (6 cases), fever (4 cases), and headache (3 cases). These findings correlate with previous research, which shows that hypotension is the most common complication in hemodialysis patients, affecting 28.7% of them due to fluid shifts and vascular instability. Other frequent issues include hypertension (17%) and nausea or vomiting (11.7%) [7], often linked to electrolyte imbalances and rapid fluid removal [21]. Additionally, backache and chest pain may arise from prolonged dialysis and cardiovascular stress. Recognizing these complications is vital for improving hemodialysis protocols and patient outcomes [22]. A comprehensive local study highlighted that hypertension emerged as the second most prevalent cause, afflicting 3.54% of the patient population examined [23]. In contrast, Mahmood et al. observed a strikingly lower prevalence of intradialytic hypertension, noting its occurrence in just 1% of patients [24]. These varying statistics underscore the complexities and discrepancies in hypertension prevalence among different patient groups undergoing treatment. Another study highlights the high prevalence of dialysis complications, with hypotension (10%) being the most common, followed by nausea/vomiting (5.24%), hypertension (5.06%), muscle cramps (4.71%), and headaches (4.54%). Less frequent issues (<3%) included back pain, chest pain, fever, chills, and itching. Notably, half of the complications occurred in diabetic patients, emphasizing their increased risk. While no deaths were directly linked to these events, vigilant monitoring and targeted care strategies are essential to improve patient outcomes [4, 25].

CONCLUSIONS

In conclusion, dialysis complications are prevalent, with hypotension being the most commonly experienced issue. Other frequent complications include nausea, vomiting, hypertension, muscle cramps, and headaches. Additionally, less common symptoms such as back pain, chest pain, fever, chills, and itching add to the discomfort of patients. Diabetic individuals tend to be more vulnerable to these complications, which emphasizes the importance of better monitoring and tailored management approaches. While no fatalities have been directly attributed to these complications, it remains crucial to refine dialysis protocols and implement preventive measures to improve patient safety and outcomes.

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Authors Contribution

Conceptualization: MSB
Methodology: MSB, SA[1], SA[2], SA[3], ZI, UA
Formal analysis: UA
Writing review and editing: SA[2], SA[3]

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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