

Prevalence of Intradialytic Complications Among Patients on Maintenance Hemodialysis: A Descriptive Cross-Sectional Study in a Secondary Referral Hospital

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Abstract

Background

Government funding for maintenance hemodialysis has expanded access to dialysis services in LMICs such as Nepal. However, many dialysis units continue to face persistent challenges related to infrastructure, staffing, financial resources, and supply availability. In many such centers, hemodialysis is performed without on-site nephrologist supervision. This study aims to assess intradialytic complications and describe the challenges of providing maintenance hemodialysis in a resource-limited secondary referral center in Nepal, where dialysis care is delivered by medical practitioners and trained nurses without an on-site nephrologist. To our knowledge, this is the first study from a secondary referral center in Nepal to report intradialytic complications in such a setting.

Methods

This retrospective descriptive cross-sectional study was conducted at a secondary-level hospital (Dhading Hospital). A total of 33 patients receiving maintenance hemodialysis over a 3-month period were included. All dialysis sessions during this period ($n = 764$) were monitored for intradialytic complications. The prevalence of complications, including hypotension, hypoglycemia, hypertension, chills and rigor, nausea, and vomiting, was calculated.

Results

A total of 764 hemodialysis sessions from 33 patients were analyzed over the three-month study period. Of these, 110 sessions (14.4%) were associated with one or more intradialytic complications, with 26 of 33 patients (78.8%) experiencing at least one complication. Two patients died during the study period due to causes unrelated to intradialytic complications. A total of 149 complication events were recorded across the 110 affected sessions. Hypoglycemia was the most frequent complication (33.5%), followed by intradialytic hypertension (12%), intradialytic hypotension (9.4%), headache (8.7%), vomiting (8.7%), and muscle cramps (8.7%). Less common complications include hypoxia, dyselectrolytaemia, rigors (3.3% each), fever (2%), and tachycardia (1.3%). Most patients (72.7%) were on a twice-weekly hemodialysis schedule. Arteriovenous fistula was the predominant vascular access used (93.9%).

Conclusions

Intradialytic complications were common among patients receiving maintenance hemodialysis in this resource-limited secondary hospital, affecting more than three-quarters of patients during the study period. Hypoglycemia emerged as the most frequent complication, followed by intradialytic hypertension and hypotension. This highlights a pattern distinct from other tertiary center studies in Nepal and world-wide. These findings highlight the importance of vigilant monitoring, staff training, and standardized management protocols for intradialytic complications in dialysis units operating with limited resources and without on-site nephrologist supervision. Further multicenter studies are needed to identify risk

factors, associations, and formulate strategies to improve dialysis safety and quality of care in similar settings.

Background

Chronic kidney disease is characterized by abnormalities in kidney structure or function that persist for at least three months and are associated with adverse health consequences. (1) Worldwide, chronic kidney disease is estimated to affect around 850 million people, with about 4 million requiring kidney replacement therapy due to kidney failure. By the year 2050, chronic kidney disease is expected to rank as the fifth leading cause of death globally. (2) A recent survey conducted by the International Society of Nephrology revealed that many countries do not have adequate routine facilities for screening and diagnosing kidney disease, and even fewer are equipped to provide care for patients with end-stage renal disease. Most individuals affected by chronic kidney disease (CKD) reside in low- and middle-income countries (LMICs); however, there is a lack of sufficient evidence to guide CKD management in these resource-constrained settings, where access to renal replacement therapy remains limited. A study by Liyanage T, Ninomiya T et al. estimated that nearly 2.284 million premature deaths may have occurred in LMICs due to the unavailability of renal replacement therapy. The greatest treatment disparities were observed in low-income countries, particularly within Asia. (3) These findings emphasize the need for innovative strategies in chronic kidney disease management and highlight the importance of adapting CKD care standards according to the healthcare resources and capacities of individual nations. However, only a limited number of rigorous chronic kidney disease care models have been described in low- and middle-income countries, and there is insufficient evidence regarding the most effective, affordable, and sustainable approaches to CKD management. The most successful care models were those that incorporated CKD management into national chronic disease programs or emphasized strengthening the knowledge and services provided by primary care and allied health professionals.(4)It is estimated that nearly 90% of the world's population receiving kidney replacement therapy lives in upper-middle-income or high-income countries, despite these countries accounting for only about half of the global population with CKD.(5) The 2025 World Health Organization kidney disease resolution urges member states to strengthen health systems and implement policies that support prevention, early detection, and management of kidney disease, with an emphasis on equitable access to care. Improving access to kidney replacement therapy is expected to reduce premature deaths from kidney disease in resource-limited settings. In addition, prioritizing kidney transplantation over dialysis is considered more cost-effective and is associated with better quality of life outcomes. (6)

In 2019, CKD ranked as the 10th leading cause of death in Nepal which shows that it is a major public health problem.(7) A tertiary hospital-based study in Chitwan, Nepal, has shown the prevalence of ESKD as 11.36%.(8) The first dialysis in Nepal was in the form of intermittent peritoneal dialysis. In 1987, hemodialysis service was started in Bir Hospital with two functioning HD machines.(9) Since 2016, Nepal's Ministry of Health has started free lifetime hemodialysis services. After this there has been noticeable growth in RRT and its availability in resource limited setting. However, the majority nephrologists reside within the major city areas. As a result, the majority of hemodialysis in resource-

limited settings is carried out without on-site nephrologist supervision. In addition to this, most of the maintenance HD in Nepal is done twice weekly with each session lasting 3 to 4 hours.(9)

Following the initiation of government-funded free hemodialysis services in Nepal, dialysis facilities have expanded into resource-limited secondary hospitals.(9) These settings often operate with constrained infrastructure, limited specialist supervision, and variable staffing patterns, which may influence the occurrence and management of intradialytic complications. Diagnosis and management of intradialytic complications of hemodialysis are crucial because such complications could be managed successfully without the need for termination of the dialysis procedure. Also, understanding the distribution of intradialytic complications across patient demographic and clinical characteristics improves preparedness to manage dialysis-related events, thereby enhancing the quality of patient care.

There is limited context-specific evidence regarding the burden, pattern, and contributing factors of intradialytic complications in secondary hospital settings. This knowledge gap may hinder the development of targeted quality improvement strategies and safe dialysis practices in such environments. Therefore, this retrospective cross-sectional study design aims to assess the spectrum of intradialytic complications and identify associated challenges in a secondary hospital setting and address the gap.

Methods

This is a descriptive retrospective cross-sectional study done on site at Dhading Hospital, Dhading, which is a secondary hospital without an on-site nephrologist. The study was conducted from 16 December 2025 to 14 March 2026 for a total duration of 3 months. The dialysis unit has 4 regular dialysis machines with 3 shifts per day of dialysis running every day. Majority patients undergo dialysis of 4 hours twice a week. Since 33 patients enrolled in the dialysis unit all fulfilled the inclusion criteria, total enumeration (census) sampling was used to select participants for the study. Two patients died due to causes other than intradialytic complications. A total of 764 sessions were analyzed (approximately 23 sessions per patient).

The absence of a standardized definition for clinically significant intradialytic hypotension (IDH), along with variability in available data, has resulted in the adoption of diverse diagnostic criteria across clinical practice and research studies. In this study, IDH was defined as a decrease in systolic blood pressure of ≥ 20 mm Hg or a reduction in mean arterial pressure (MAP) of ≥ 10 mm Hg accompanied by symptoms. (10) Likewise, the lack of a universally accepted definition for intradialytic hypertension has led to variability in diagnostic criteria across studies. In this study, intradialytic hypertension was defined as an increase in MAP of ≥ 15 mm Hg during or immediately after hemodialysis. (11) Hypoglycemia was defined as a blood glucose concentration < 70 mg/dL during dialysis. (12)

A self-structured questionnaire was made for recording patients demographics, diagnosis and nursing record sheets were utilized to review intradialytic complications, management and other dialysis related details.

Data collection was supervised by the authors. Descriptive data analysis was done using Microsoft 365 Excel.

Results

Study population and baseline characteristics

A total of 33 patients with CKD Stage 5 under maintenance hemodialysis at Dhading Hospital were enrolled over a three-month study period. The cohort comprised 21 males (63.6%) and 12 females (36.4%), with a male-to-female ratio of approximately 1.75:1(Fig. 1). The mean age of participants was 49.5 ± 16.4 years with a range of 23–79 years, indicating a predominantly middle-aged to older adult population. The mean body weight was 53.4 ± 13.3 kg with a range of 30.7–90.7 kg.

Regarding dialysis, patients had been on hemodialysis for a mean duration of 20.6 ± 16.5 months ranging from 1–85 months, reflecting considerable heterogeneity in dialysis exposure within the cohort (Table 1). The range of each hemodialysis session was from 2–4 hours (Fig. 2). The mean ultrafiltrate volume removed per session was 2.4 ± 1 liter, ranging from 0.1 to 4 liters. **[Insert Fig. 1, Table 1 and Fig. 2 here respectively]**

Table 1 Total duration for hemodialysis		
Total duration of hemodialysis	Number	Frequency
≤ 12 months	7	21.2%
12–36 months	21	63.6%
≥ 36 months	5	15.2%

Hemodialysis session and vascular access

Most patients (n = 24; 72.7%) received twice-weekly hemodialysis, while 8 patients (24.2%) underwent thrice-weekly sessions, and one patient (3.0%) received once-weekly dialysis (Table 2). Arteriovenous (AV) fistula was the predominant vascular access, utilized in 31 patients (93.9%). A permanent tunneled catheter and a subclavian catheter were each used in one patient (3% each) (Table 3). **[Insert Table 2 and Table 3 here]**

Table 2
Frequency of hemodialysis session per week

Frequency of hemodialysis session per week	Number(n)	Frequency (%)
Once weekly	1	3.0%
Twice weekly	24	72.7%
Thrice weekly	8	24.2%

Table 3
Vascular access used

Vascular access used	Number(n)	Frequency (%)
Arteriovenous (AV) fistula	31	93.9%
Permanent (tunneled) catheter	1	3%
Subclavian catheter	1	3%

Intradialytic complications

A total of 764 hemodialysis sessions were analyzed over the three-month study period. Of these, 110 sessions were associated with one or more intradialytic complications, yielding a prevalence of intradialytic complications of 14.4%. 26 of 33 participants (78.8%) experienced one or more complications during the study period.

Hypoglycemia was the most frequently observed complication, accounting for 50 of 110 recorded complication events (45.5%). This was followed by hypertension (16.4%), hypotension (12.7%), and headache, vomiting, and muscle cramps (11.8%) each. Less frequently encountered complications including hypoxia, dyselectrolytaemia, and rigors (4.5%) each, fever (2.7%), tachycardia (1.8%), and miscellaneous others like abdominal pain, loose stool, restlessness, body aches and shortness of breath (7.3%). The full spectrum and frequency distribution of intradialytic complications are shown in Fig. 3.

[Insert Fig. 3 here]

Discussion

Previous studies have reported considerable variation in intradialytic complications across different settings, which are summarized in Table 4. The tertiary centers in Nepal commonly reported chills/rigor or nausea/vomiting (13, 14). Studies from Eritrea (15) and India (17, 18) identifies hypotension as predominant complication whereas study in Tanzania (16) has shown intradialytic hypertension as most common complication. In contrast, hypoglycemia was the most frequent complication in our study, accounting for 33.5% of all events. Comparison of these studies has been done in Table 4. All these different studies having different prevalence rates of complications can be attributed to differences in

patient characteristics, dialysis practices, nutritional status, healthcare resources limitations, staff expertise, machine quality, monitoring protocols, and adherence to treatment. In addition, variations in sample size, definitions of complications, and data collection methods between studies also contribute to differing prevalence rates. **[Insert Table 4 here]**

Table 4
Characteristics and comparison of different studies

Study	Study Duration	Sample size	Overall Complication Rate	Most Common Complication
1. Bartula et al. (2019) BPKIHS, Nepal (13)	- 6 months	- 228 patients	- 58.3% of all patients	- Chills/Rigor
2.Sah et al. (2023) Birat medical college (BMC), Nepal (14)	- 4 months	- 72 patients	- Nearly all patients	- Nausea/ Vomiting
3. Raja et al. (2020) Eritrea (15)	- 5 months	- 29 patients	- 30.7% of all sessions (573 sessions)	- Hypotension
4. Dugilo et al. (2025) Tanzania (16)	- 2 months	- 215 patients	- 36.6% of all sessions (2111 sessions)	- Hypertension
5. Nilugal et al. (2026) Karnataka, India (17)	-18 months	- 90 patients	- 33.2% of all sessions (205 sessions)	- Hypotension
6. Gopal Singh et al. (2015) Banaras Hindu University (BHU), India (18)	-2 years	-2325 patients (790: Acute Renal Failure (ARF), 1535: Chronic Renal Failure (CRF))	- Not Reported (NR)	- Hypotension (both group)
7.Present study Dhading hospital, Nepal	- 3 months	- 33 patients	- 14.4% of sessions (764 sessions) - 78.8% of all patients	- Hypoglycemia

Historically, glucose-free dialysate was strongly associated with intradialytic hypoglycemia. Although modern dialysis units generally use glucose-containing dialysate, continuous glucose monitoring studies

have shown that hypoglycemic episodes still occur during and after dialysis occurring particularly common among diabetic patients receiving insulin or oral hypoglycemic agents. (19) The true burden remains likely underestimated as many episodes are asymptomatic and detectable only through continuous glucose monitoring. The absence of classical symptoms does not exclude hypoglycemia, highlighting the importance of routine glucose surveillance in high-risk patients.(20) Several setting-specific factors likely amplified this burden in our study: the absence of on-site nephrologist supervision contributed to inadequate oral hypoglycemics and insulin dose adjustment on dialysis days; poor nutritional knowledge and affordability leading to poor nutritional status in the cohort as hypoglycemia is strongly associated with hypoalbuminemia and intradialytic hypotension, highlighting the role of nutritional status and hemodynamic instability in its development; and the unavailability of intradialytic snacking, a simple yet effective preventive measure not practiced in our center. Use of Meglitinides which carries a lower hypoglycemic risk than insulin in this population, alongside nephrologist-guided dose titration, structured glucose surveillance, and intradialytic nutritional support, can be the most accessible intervention target in a resource-limited hemodialysis setting. (21)

Intradialytic hypertension is another common complication affecting at least 10% of hemodialysis patients and is strongly associated with extracellular volume overload. Although the precise mechanisms underlying the rise in vascular resistance during dialysis remain incompletely understood, optimization of fluid status, management of comorbid conditions, and the use of vasodilatory antihypertensive agents are considered important therapeutic strategies. Additionally, reducing dialysate sodium concentration has shown potential in mitigating intradialytic blood pressure elevations. (22) Beyond an acute hemodynamic event, intradialytic hypertension has been associated with increased hospitalization rates, cardiovascular events, and all-cause mortality, suggesting that its presence should prompt careful evaluation of volume status, antihypertensive therapy, and dialysis prescription parameters. (23)

The third most common complication observed in this study was intradialytic hypotension although it remains the most frequent intradialytic complication globally. Intradialytic hypotension (IDH) is primarily caused by reduced effective circulating blood volume coupled with an inadequate compensatory neurohumoral response. These episodes can cause transient organ hypoperfusion and ischemia, and recurrent occurrences may ultimately lead to irreversible organ damage. (24) Multiple strategies have been proposed to reduce the frequency and severity of intradialytic hypotension. These include optimizing the dialysis prescription through measures such as the use of cool dialysate, ultrafiltration profiling, sodium profiling, and high-flux dialysis. In addition, intradialytic measures like midodrine administration, fluid boluses, regulated food intake, intradialytic exercise, and intermittent pneumatic compression of the lower limbs may help stabilize hemodynamics. Interdialytic strategies including minimizing interdialytic weight gain and adjusting antihypertensive medications, may also be beneficial. In cases with recurrent or refractory episodes, transitioning to peritoneal dialysis may be considered.(25)

These findings emphasize the importance of establishing curated, standardized management protocols for intradialytic complications that incorporate emerging research evidence and are specifically tailored

to the populations most likely to benefit from the intervention.

This study was limited by its retrospective design and reliance on nursing documentation, a single-center setting with a small patient population (33 patients despite 764 sessions), and a short three-month duration, which may restrict the generalizability of findings and their representation of long-term intradialytic complication trends.

Conclusions

This study demonstrates that intradialytic complications are highly prevalent in a resource-limited hemodialysis unit in a secondary hospital setting in Nepal, occurring in 14.4% of all sessions and affecting 78.8% of all patients over a three-month period. In this study hypoglycemia emerged as the most frequent complication (33.5%), a pattern distinct from most tertiary center studies, including those from Nepal, which have reported intradialytic hypotension or chills and rigors as predominant events.(13, 14) Given that hypoglycemic episodes in hemodialysis patients carry significant mortality risk and many episodes are asymptomatic,(12, 20) this finding has direct clinical implications for patient safety in similar resource-constrained centers lacking on-site nephrologist support.

Intradialytic hypertension (12%) and hypotension (9.4%) were the second and third most frequent complications, respectively. The distribution of complication burden observed in this study, occurring in the absence of on-site nephrologist supervision and with limited infrastructure, highlights a critical gap in dialysis care quality in secondary hospital settings. As government-funded hemodialysis services continue to expand into resource-limited centers across Nepal and comparable LMICs (3, 9), context-specific evidence such as this is essential to inform the development of targeted quality improvement strategies, staff training protocols, and structured clinical monitoring guidelines. Future studies with larger sample sizes, multicenter designs, and systematic comorbidity profiling are needed to identify modifiable risk factors and establish evidence-based safe dialysis practices in these settings.

Abbreviations

LMIC

Low and Middle Income Countries

IDH

Intradialytic Hypotension

CKD

Chronic Kidney Disease

HD

Hemodialysis

MAP

Mean Arterial Pressure

RRT

Renal replacement Therapy
AV
Arteriovenous
ESKD
End Stage Kidney Disease

Declarations

Ethics approval and consent to participate

The research has been reviewed and granted approval through the expedited review process for its implementation. The research was approved by the Nepal Health Research Council with reference number 1765.

Consent for publication

Not Applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

AC: Research question, study design, ethical approval, manuscript writing.

PC: Manuscript writing, Data analysis

AK: Data collection, Manuscript editing

LS: Data collection

SS: Data collection

BB: Supervising data collection, manuscript editing, team supervision

TCJ: Supervising data collection, manuscript editing, team supervision

KNC: Data analysis

All authors read and approve of the final manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Not Applicable

Data Availability

The data is with the corresponding author and is available upon request with the permission of the ethical committee of National Health Research Council.

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Figures

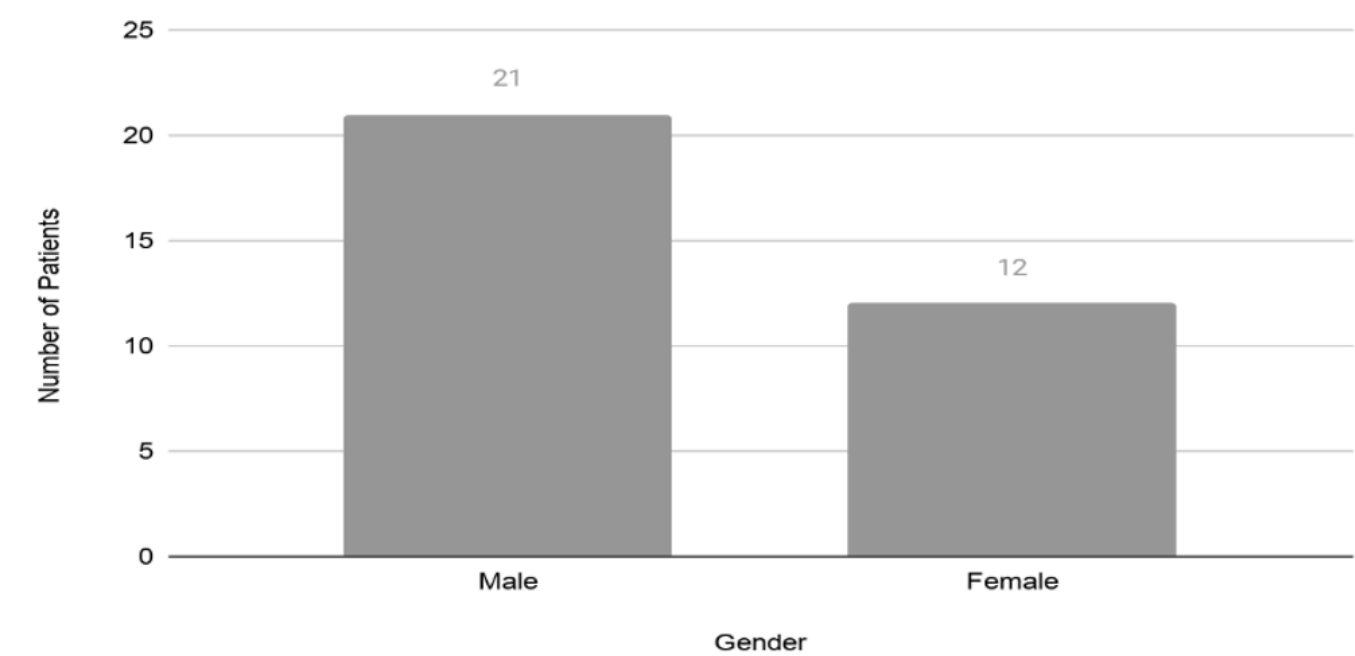


Figure 1

Sex distribution of patients under maintenance hemodialysis

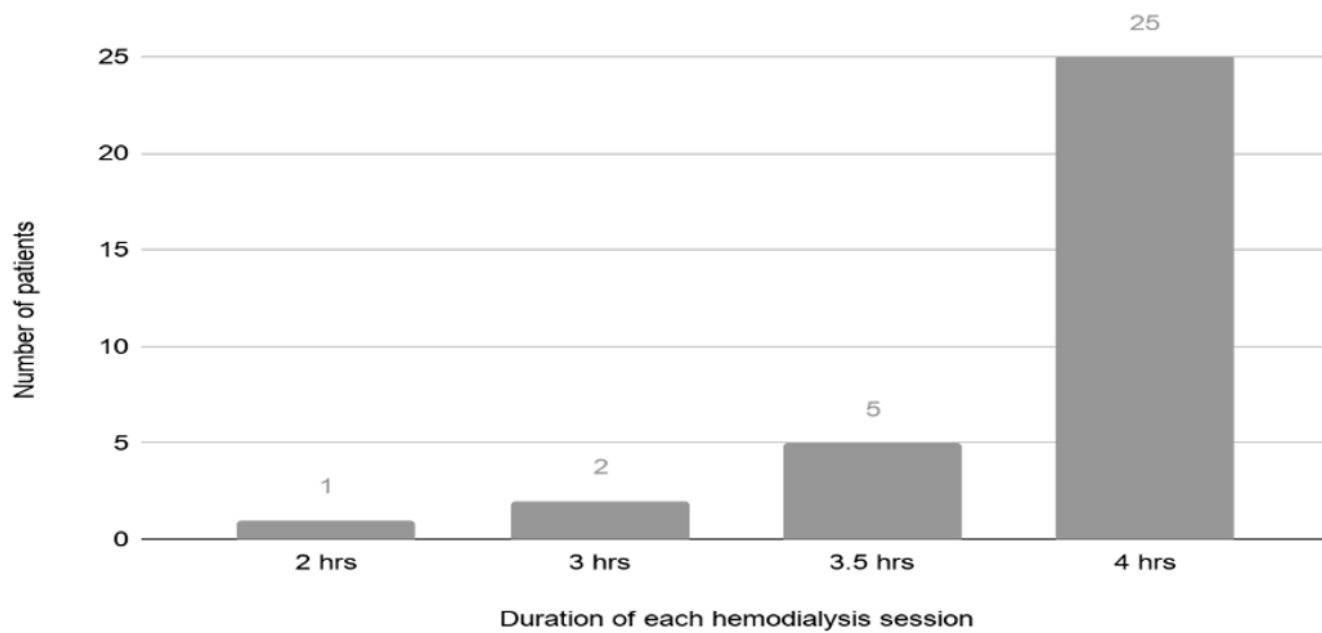


Figure 2

Duration of each hemodialysis session

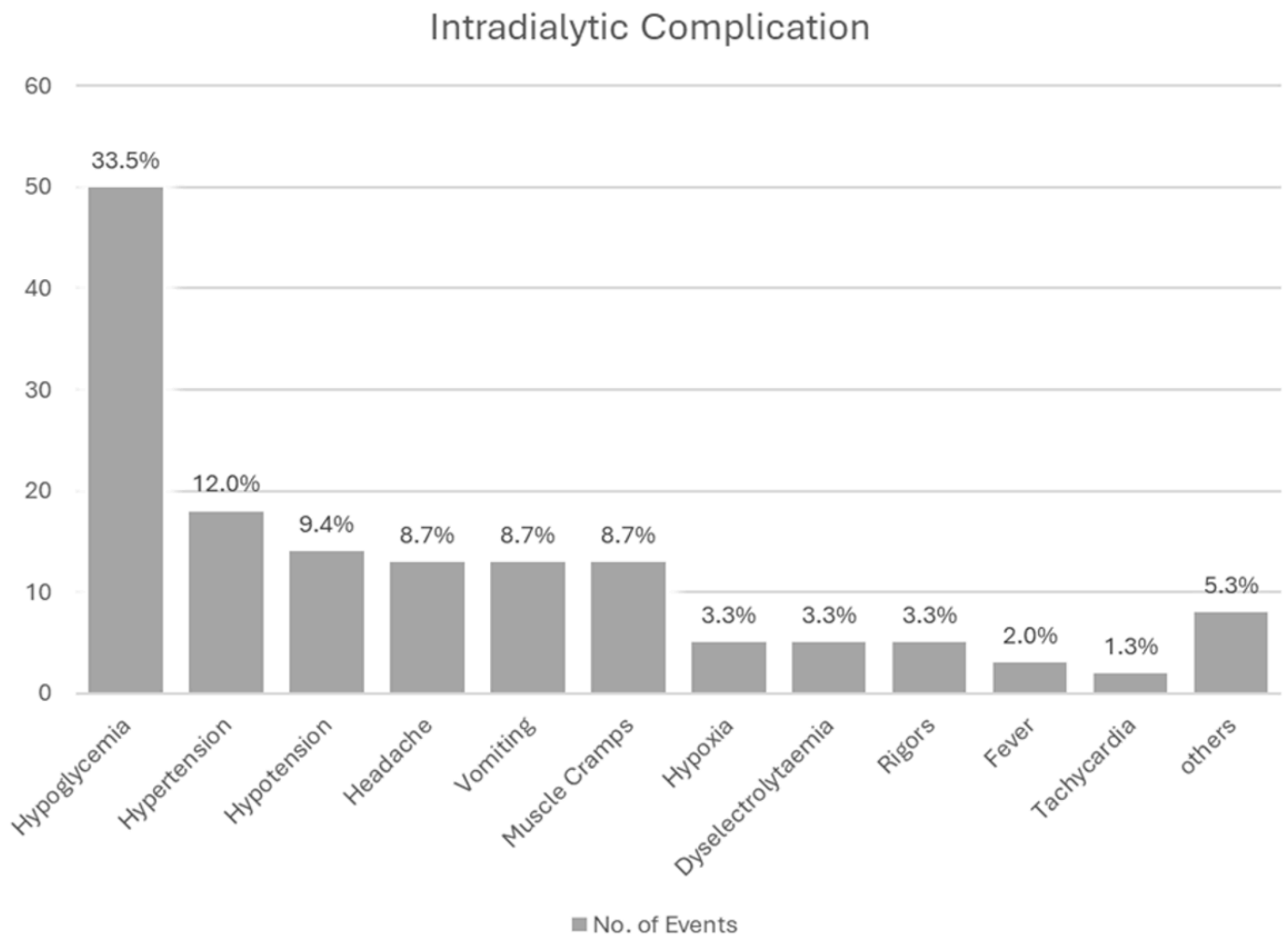


Figure 3

Frequency distribution of intradialytic complications