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Original Article

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Antibiotic Prescribing Practice in the Intensive Care Unit of a Nigerian Teaching Hospital

Ige Olufemi[1,2], Ojo Olawale[2], Adewumi Oluwaseyi[2], Agah Overcomer[2]

ABSTRACT

Background: *Antibiotics are vital in the prevention and treatment of bacterial infections. However, prescribing practices often deviate from established guidelines with prolonged durations of surgical prophylaxis, redundant antibiotic combinations, and a significant reliance on broad-spectrum agents. This study aims to determine antibiotic prescribing practices at our teaching hospital.*

Methods: *This was a prospective, descriptive, cross-sectional study of adult patients admitted to the ICU at the University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria. The study participants were critically ill patients between the ages of 6 months and 65 years who were admitted to the ICU. Using a questionnaire, information such as age, sex, diagnosis, antibiotic prescription, regularity of administration, use of microbiological investigations, and outcome of ICU care was extracted from the patients' hospital files and recorded. Data from this study were summarized and reported as means ± standard deviation, frequencies, or proportions of the total. A p-value of less than 0.05 was considered statistically significant.*

Results: *A total of 128 ICU patients were enrolled in the study. One hundred and twenty-four (96.88%) patients were prescribed antibiotics. Antibiotic prescriptions were for prophylactic reasons in 56 (45.16%) patients and for therapeutic reasons in 68 (54.84%) patients. All antibiotic prescriptions were empirical. The most frequently prescribed antibiotic was ceftriaxone. The most frequently prescribed antibiotic combination was Ceftriaxone/Metronidazole. There was no statistically significant difference in gender (0.7651) and age (p = 0.0775) between those who survived to ICU discharge and those who died. Prophylactic antibiotic prescription was associated with survival to ICU discharge compared to therapeutic prescription (p = 0.0018).*

Conclusion: *Ceftriaxone was the primary empirical ICU antibiotic therapy, while metronidazole was used strategically for anaerobic coverage. In this study, critical care physicians favored empirical therapy over targeted therapy.*

Keywords: Antibiotics, Critical care, Prescription practices, Antibiotic stewardship

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1. Introduction

It is not only important to select the right medications; the prescribing pattern must also be appropriate. Medication must be administered in the right dosage, frequency, and for the appropriate duration. Antibiotics are vital in the prevention and treatment of bacterial infections. Their use has contributed to the control of life-threatening diseases. However, when they are not prescribed appropriately, the beneficial results may not be apparent. An appropriate prescription involves using the right antibiotic at the right dose for the right duration.

In Africa, and especially in Nigeria, the prevalence of antibiotic use among hospitalized patients is notably high, with rates ranging from 37.7% in South Africa[1] to 80.1% in Nigeria.[2] Within the hospital, the ICU is associated with a higher rate of antibiotic usage than other wards.[3] The Intensive Care Unit (ICU) is a specialized section of the hospital devoted to the care of critically ill patients, many of whom either have sepsis or have a high risk of healthcare-associated infections due to invasive procedures and compromised immunity. Antibiotics play an important role in the management of these patients.

Despite their benefits, antibiotics have side effects, some of which may be serious adverse effects; therefore, patients should not be exposed to them unnecessarily.[4] The misuse of antibiotics contributes to the development of antibiotic resistance, which compromises the effectiveness of antibiotics.[5,6] Antibiotic resistance has the potential to reduce the availability of antibiotics effective in the fight against infections, which may threaten critical care management and lead to millions of deaths worldwide if not addressed.

To prevent the inappropriate use of antibiotics, organizations such as the World Health Organization have established guidelines to guide physicians in the prevention and treatment of infection.[7] While the use of these guidelines is encouraged, it has been suggested that prescribing practices often deviate from established guidelines, with prolonged durations of surgical prophylaxis, redundant antibiotic combinations, and a significant reliance on broad-spectrum agents observed in Nigerian settings.[2] Antibiotic stewardship programs are important to ensure strict adherence to established guidelines.

Despite recognition of these challenges, there remains a substantial gap in the literature regarding detailed antibiotic prescribing patterns, particularly in Nigerian ICUs. The objective of this study is to determine the most frequently prescribed antibiotics, their duration of use, the regularity of administration, and their association with the outcome of ICU admission. This knowledge is required in designing appropriate antimicrobial stewardship interventions and guiding policy development.

2. Method

Study setting

This study was carried out at the Intensive Care Units of the University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria. Our hospital is a tertiary health institution located in the north-central region of Nigeria. The hospital has two adult ICUs with a total of 13 beds where surgical and medical critical care cases are managed.

Study design

This was a prospective, observational cross-sectional study of adult patients admitted into the ICU.

Study population

The study participants were critically ill patients between the ages of 6 months and 65 years who

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were admitted to the ICU. Exclusion criteria included the patient's or relatives' refusal to participate in the study.

Ethical consideration

Ethical approval was obtained from the University of Ilorin Teaching Hospital Ethical Review Committee before the commencement of the study. Also, in accordance with the Declaration of Helsinki, written informed consent, signed and dated, was obtained from all participants after the investigator provided them with a detailed explanation of the procedure. All information obtained from the patients was treated with strict confidentiality, and the data obtained was used strictly for research purposes.

Sample size determination

The sample size was determined using the Cochran formula[8] for observational studies, with the estimated proportion of the attribute in the population set at 0.8, as reported in a previous study.[2] After adjusting for a finite population and considering the attrition factor, the final sample size was 117.

Data collection

The participants were enrolled in the study on the day of admission. Using a questionnaire developed by the authors, demographic information, including age and sex, was extracted from patients' hospital files and recorded. Other information, such as diagnosis, antibiotic prescription, regularity of administration, use of microbiological investigations, and outcome of ICU care, was also documented. The patients were visited every day to update information on antibiotic usage and the outcome of ICU care. Data were collected by two resident doctors in the department of anesthesia, who had been trained to use the questionnaire.

Methods to minimize bias/errors

To ensure reliability and validity and prevent measurement errors, a pilot test was conducted to identify potential challenges with the questionnaire. The pilot test was conducted in the surgical ward and the operating theatre on 20 adult patients scheduled for elective surgical procedures. The Cronbach's alpha was 0.76. Pilot test participants were not subsequently included in the research. Necessary adjustments were subsequently made to the questionnaire before the study commenced. Furthermore, measurement errors were addressed by ensuring that the anesthesia residents who collected the data had been specifically trained to use the questionnaire.

Variables

The study's outcome variables are the type of antibiotic prescribed, the frequency of antibiotic prescription, and the regularity of antibiotic administration. The exposure variable was the availability of microbiological evidence at the time of prescription. The predictors were patient demographics (age and sex).

Data analysis

Data from this study were summarized and reported as means ± standard deviation, frequencies, or proportions. Qualitative variables, such as gender and surgical outcome, were analyzed with the chi-square test, while quantitative variables, such as antibiotic duration, were analyzed with the Student's t-test. The computer software package was SPSS version 21.0. A p-value of less than 0.05 was considered statistically significant.

3. Result

Demographic data and indication for admission

A total of 128 ICU patients were enrolled in the study. There were 70 males and 58 females. The

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mean age of the participants was 40.16 years, with a range of 6 months to 80 years.

ICU admission

The indications for ICU admission were postoperative care 134, stroke 8, traumatic brain injury 8, Eclampsia

/ Preeclampsia 6, sepsis 4, burns 4, and acute chest syndrome 4. There were also two admissions each of viral encephalitis, aspiration pneumonia, acute pulmonary oedema, pulmonary embolism, HELLP syndrome, and penetrating thoracic injury.

The ICU admission days were a total of 382 days, with a range of 1-16 days. The mean ICU admission duration was 2.98 days.

Antibiotic prescription pattern

One hundred and twenty-four (96.88%) patients were prescribed antibiotics, while 4 (3.12%) patients were not. Antibiotic prescriptions were for prophylactic reasons in 56 patients and for therapeutic reasons in 68 patients.

All 124 patients who were prescribed antibiotics had their prescriptions written before ICU admission, and none had microscopy, culture, or sensitivity tests performed before antibiotic prescription. Therefore, all prescriptions were empirical.

The most frequently prescribed antibiotic was ceftriaxone 94. Others were metronidazole (78), levofloxacin (20), meropenem (16), gentamicin (6), ceftazidime (4), and azithromycin (4).

The most frequently prescribed combination of antibiotics was Ceftriaxone/Metronidazole 56, meropenem/metronidazole 14, amoxicillin/clavulanic acid 14, levofloxacin/ceftriaxone 10, levofloxacin/meropenem 6, ciprofloxacin/metronidazole 6, piperazine/tazobactam 4, piperazine/tazobactam/metronidazole 4. The most frequently prescribed antibiotics as second-line treatment were Meropenem 12, Levofloxacin 10, and piperazine/tazobactam 4.

Antibiotic administration

Thirty-six (29.03%) patients had one antibiotic prescribed and administered, and 60 (48.39%) patients had two antibiotics prescribed and administered. Eighteen (14.52%) patients received three antibiotics, while 10 (8.07%) received four.

Antibiotic administration was regular in 108 (87.10%) patients and irregular in 16 (12.90%) patients. Twelve (9.68%) patients missed less than 25% of the scheduled doses, while 4 (3.23%) missed between 25% and 50% of the scheduled doses.

Outcome of ICU admission

Sixty-eight (53.13%) patients were discharged from the ICU, while 60 (46.88%) died. There was no statistically significant difference in sex with a p value of 0.7651 (fig 1). Also, those who survived to ICU discharge had a mean age of 42.45 (16.27) years, while those who did not survive had a mean age of 37.57 (14.53) years ($p = 0.0775$), which was not statistically significant. The indication for antibiotic prescription differed significantly between survivors to ICU discharge and those who died, with prophylactic antibiotics associated with survival to ICU discharge ($p = 0.0018$). The mean duration of antibiotic use ($p = 0.3512$), the number of antibiotics used ($p = 0.2472$), and the regularity of antibiotic administration ($p = 0.5828$) did not differ significantly between ICU outcomes (Table 1).

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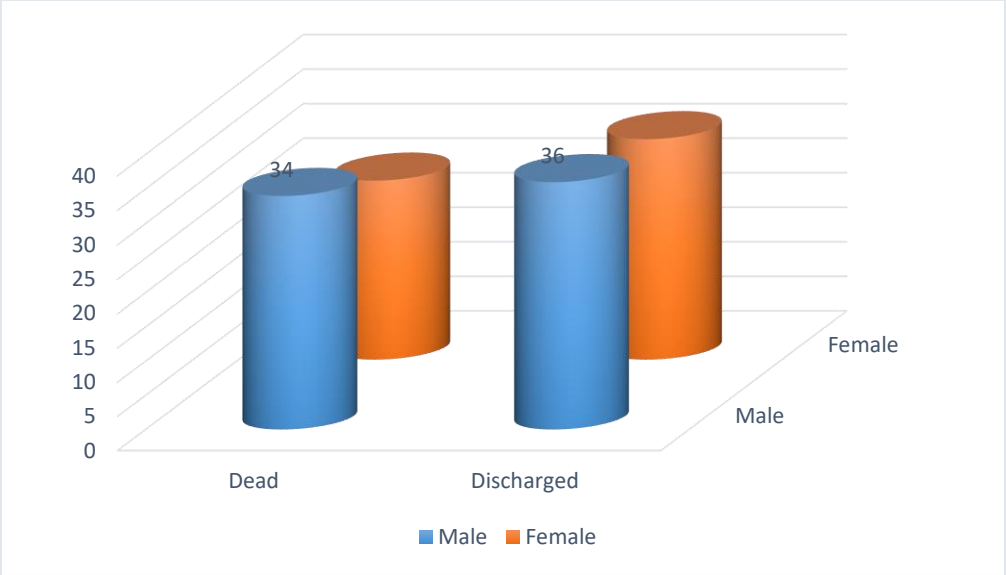

Fig 1: Outcome of ICU admission with gender

Table 1: Outcome of ICU admission and antibiotic use

	Dead	Discharged		
Sex			0.0893	0.765114
Male	34	36		
Female	26	32		
Indication for AB			9.7236	0.001819
Prophylactic	14	42		
Therapeutic	44	24		
Mean duration of AB use	3.344827586 (1.12)	3.088235294 (1.03)	0.9396	0.3512
Number of AB use			5.4156	0.2472
None	2	2		
1	24	12		
2	20	40		
3	8	10		
4	6	4		
Regularity			1.0798	0.5828
Regular	48	60		
< 25%Missed doses	8	4		
25-50% Missed doses	2	2		

4. Discussion

The findings of this study reveal a high rate of antibiotic use (96%) in the ICU. All antibiotic prescriptions were empirical, as none were preceded by prior microbiological testing. This practice underscores a critical reliance on empirical

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therapy, reflecting the urgency of managing severe infections in critically ill patients and potential systemic challenges in the ICU setting related to diagnostic resources and protocols.

The high rate of antibiotic use in this study reflects the findings of previous studies that the rate of antibiotic use is much higher in the African continent than in Europe. This is probably due to the impression that communicable diseases are more of a challenge in developing countries than in the developed ones.[9] Infectious diseases like acute respiratory infections, diarrheal diseases, and HIV/AIDS result in significant morbidity, loss of productivity, and mortality within the African continent.[9] Inadequate water, sanitation facilities, and hygiene make the spread of infectious diseases more likely.[10] The increased burden of infectious diseases in Africa creates an availability bias (the tendency for something to be judged more frequently if it readily comes to mind), which may increase the likelihood of the diagnosis of sepsis in critical care units within Africa.[11]

Also, the high rate of antibiotic use may reflect the study's location. Antibiotic prescription is reported to be higher among critically ill patients admitted to the ICU when compared to other patients in regular wards. [12] This is due to the severity of the cases managed there and the fact that many patients are susceptible to infections from reduced immunity. The use of multiple procedures, such as central line catheterization, which breaches the skin and mucous membranes, also makes patients vulnerable to infections.

There are conditions in the ICU that mimic infections, exhibiting nonspecific signs such as fever and tachycardia. These may result in diagnostic challenges and inappropriate prescriptions. The availability of rapid point-of-care tests that reliably distinguish infection from non-infection will help prevent unnecessary prescriptions of broad-spectrum antibiotics.[13] A study compared the administration of antibiotics to ICU patients on clinical evidence of infection (aggressive strategy) with similar antibiotic administration only after objective evidence of infection (conservative strategy) and found that the conservative approach was associated with lower all-cause mortality, more initial appropriate therapy, and shorter duration of therapy.[14] The clinical application of this finding may be challenging in the setting of severe infection when time is of the essence and only microbiological cultures that take days to yield results are available. The availability of rapid, reliable point-of-care tests would encourage appropriate antibiotic stewardship.

The increasing use of biomarkers of sepsis has improved the ability to differentiate infectious from non-infectious diseases. In critically ill patients, both procalcitonin and C-reactive protein were useful for diagnosing sepsis, but procalcitonin has been found to have greater specificity, sensitivity, and positive and negative predictive values than C-reactive protein.[15]

Empirical antibiotic use is often necessary in critically ill patients with life threatening infections to permit immediate treatment. However, the absence of microbiological testing to guide antibiotic prescribing prevents targeted therapy. In this study, all the patients were prescribed antibiotics empirically. Unnecessary antibiotic prescriptions lead to adverse drug reactions and the development of opportunistic infections [16], while inappropriate antibiotic selection increases the risk of antimicrobial resistance [17], a growing global health threat. While initial empirical broad-spectrum antibiotic therapy may be necessary to prevent mortality, it is advocated

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that there should be a commitment to de-escalation and antibiotic stewardship. [18]

Ceftriaxone emerged as the most frequently prescribed antibiotic, underlining its continued role as a cornerstone in empirical therapy for critically ill patients. Ceftriaxone is a third-generation parenteral cephalosporin that works by disrupting bacterial cell wall synthesis. It has good activity against Gram-positive and Gram-negative aerobic bacteria, but minimal activity against anaerobic bacteria. It is effective in urinary tract, lower respiratory tract, skin, soft tissue, bone, and joint infections.[19] It was also the most frequently prescribed first-line antibiotic in a study in Qatar.[20] This preference likely reflects its broad-spectrum activity, favorable pharmacokinetics, and clinician familiarity, especially in settings where community-acquired infections or common hospital pathogens are prevalent. However, a study in Ethiopia found a pooled inappropriate ceftriaxone utilization rate of 55.24%. The predictors of inappropriate utilization are empirical therapy, multiple medication co-prescription, emergency and surgical ward, prophylactic use, and longer hospital stay. [21] Therefore, the finding of a 100% empirical rate of antibiotic prescription in this study cannot be encouraged.

The frequent combination of ceftriaxone with metronidazole in this study is probably motivated by a desire to cover both aerobic and anaerobic pathogens. Ceftriaxone has good coverage for aerobic gram-positive and gram-negative bacteria, but limited coverage against anaerobic bacteria, which are adequately covered by Metronidazole.[22] This approach allows a wider antibiotic coverage when the specific organism is not known or multiple bacterial agents are suspected, which is consistent with current guidelines. These medications are available and relatively affordable, making them a popular choice.

Second-line antibiotics are used when there has been a poor response to first-line antibiotics and the patient's clinical condition has deteriorated. They provide an opportunity to escalate therapy in the search for a better clinical response. This study identified meropenem and levofloxacin as the most frequently prescribed second-line antibiotics. Meropenem is a carbapenem with broad-spectrum activity usually reserved for suspected or confirmed multidrug-resistant infections. Its use as a second-line antibiotic is consistent with stewardship efforts to limit carbapenem use to cases where necessary. Levofloxacin's use as a second-line agent may relate to its broad spectrum and good tissue penetration, especially for respiratory and urinary tract infections, which are common in ICU settings.

These prescribing trends raise important considerations about antimicrobial resistance (AMR). The heavy reliance on ceftriaxone, a cephalosporin, as a first-line agent and the subsequent use of meropenem, a carbapenem, as second-line therapy may reflect increasing resistance to cephalosporins. In a study in Sudan, East Africa, an overall ceftriaxone resistance rate of 70.7% was found, with Gram-negative organisms showing a higher rate (74.2%) than Gram-positive organisms (44.4%).[23] There is therefore a need for continuous surveillance of local antibiograms and resistance mechanisms to guide empirical therapy and avoid the overuse of broad-spectrum antibiotics that drive resistance. Resistance to ceftriaxone, which may not have been present previously, may develop over time, necessitating a change in first-line antibiotic choice.

The findings from this study indicate that the overall duration of antibiotic use, the number of antibiotics prescribed, and the regularity of antibiotic administration did not differ significantly between patients who survived to ICU discharge

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and those who did not. Antibiotic administration was regular in the majority of patients;

Therefore, irregular administration may not significantly affect survival. The number of antibiotics prescribed may not have shown a significant association with survival in this study because of the diversity of cases managed in the intensive care unit. The impact of antibiotic therapy duration on ICU outcomes is complex. Early onset of antibiotic treatment is beneficial in sepsis [24], but prolonged antibiotic administration results in negative outcomes such as increased costs, increased adverse drug effects, and antibiotic resistance.[25] The lack of difference in duration of antibiotic administration and regimen between survivors and non-survivors also suggests that other factors, such as timely diagnosis, severity of illness, organ dysfunction, and availability of supportive care measures, might be more important in determining ICU mortality. These results underscore the complexity of antibiotic prescribing in the ICU, where patient outcomes are influenced by factors beyond antibiotic duration or dosing patterns.

However, patients receiving prophylactic antibiotics had a statistically higher survival rate than those receiving antibiotics therapeutically. This finding may reflect that patients receiving prophylactic antibiotics were generally at lower risk of severe infections or complications, or that prophylactic strategies effectively prevented infections that could have otherwise worsened patient outcomes. Early preventive measures with antibiotics could confer a survival advantage by reducing infection-related complications before they arise. However, this must be balanced with the risks of antibiotic overuse and the potential for the development of antimicrobial resistance. Conversely, therapeutic antibiotic use typically indicates the presence of an active infection, which inherently carries a higher risk of morbidity and mortality.

Limitations

Limitations of this study include its observational nature and the potential variability in microbiological testing that is available across different ICUs, which may affect generalizability.

5. Conclusion

This study highlights ceftriaxone's primacy in empirical ICU antibiotic therapy, the strategic use of metronidazole for anaerobic coverage, and the reserved role of meropenem and levofloxacin as critical second-line agents. While the quantity and administration patterns of antibiotics may not differ between survivors and non-survivors in the ICU, the indication for use, prophylactic versus therapeutic, is a significant factor associated with patient outcomes. Optimizing antibiotic prescribing strategies with a focus on prevention could improve survival rates, but further studies are needed to clarify the mechanisms and develop evidence-based guidelines. These insights advocate for ongoing antimicrobial stewardship interventions to balance effective infection management with minimizing resistance development in the ICU environment.

Recommendations

Future research should explore barriers to microbiological testing and evaluate interventions that enhance diagnostic stewardship alongside antibiotic prescribing practices.

Abbreviations

ICU: Intensive Care Unit

HIV: Human Immunodeficiency Virus

AIDS: Acquired Immune Deficiency Syndrome

AMR: Antimicrobial Resistance

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Author Contributions

Dr. Ige Olufemi: Contributed to the study concept and design, acquisition, analysis, and interpretation of data, drafting the article for important intellectual content, and final approval of the version to be published.

Dr. Ojo Olawale: Contributed to study design, acquisition, analysis, and interpretation of data, critically revised the article for important intellectual content, and final approval of the version to be published.

Dr. Adewumi Oluwaseyi: Contributed to study design, acquisition, analysis, and interpretation of data, critically revised the article for important intellectual content, and final approval of the version to be published.

Dr. Agah Overcomer: Contributed to study design, acquisition, analysis, and interpretation of data, critically revised the article for important intellectual content, and final approval of the version to be published.

All authors agree to be accountable for the accuracy and integrity of all aspects of the work.

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Competing interests

The authors have no conflict of interest to declare.

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Original Article

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Poor treatment outcome and associated factors among adult diabetic ketoacidosis patients admitted to Amhara regional referral hospitals at Emergency Departments, Northwest Amhara, Ethiopia, 2022; a retrospective cross-sectional study

Zemene Getie [1], Marye Getnet [1], Mahlet Gubena[1], Chilot Desta[1], Gashachew Bayleyegn[1*]

ABSTRACT

Background: *Diabetic ketoacidosis (DKA) is a significant public health problem associated with high morbidity, disability, and mortality worldwide. According to the International Diabetes Federation, the true prevalence of DKA is unknown but is estimated at around 24%. Most affected patients live in low- and middle-income countries. In Sub-Saharan Africa, particularly in Ethiopia, mortality remains high among patients who are not promptly diagnosed and treated.*

Objective: *This study aimed to assess treatment outcomes and associated factors among adult DKA patients admitted to emergency departments at Comprehensive Specialized Hospitals in Northwest Amhara, Ethiopia, in 2022.*

Methods: *A multicenter, institution-based retrospective cross-sectional study was conducted from May 14, 2017, to May 15, 2022, including 495 participants selected via systematic random sampling. Binary logistic regression was used to identify factors associated with treatment outcomes. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated, and statistical significance was declared at $p < 0.05$.*

Results: The proportion of poor treatment outcomes was 5.1% (95% CI: 3.3–7.6%). Factors significantly associated with poor outcomes included being uninsured (AOR = 3.23; 95% CI: 1.14–9.13), receiving less than 3 liters of fluid replacement (AOR = 3.86; 95% CI: 1.17–12.72), not receiving potassium replacement (AOR = 3.84; 95% CI: 1.44–10.22), and prolonged recovery time from DKA (>72 hours) (AOR = 3.93; 95% CI: 1.31–11.81).

Conclusion and Recommendation: *The proportion of poor treatment outcomes was lower than in previous studies. Lack of health insurance, inadequate fluid or potassium replacement, and prolonged recovery time were associated with poor outcomes. Prompt fluid and potassium replacement, along with strategies to reduce recovery time and increase community awareness of health insurance, are recommended to improve DKA management.*

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Keywords: Diabetic ketoacidosis, adult patients, treatment outcomes, associated factors, Amhara, Ethiopia

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1. Introduction

Diabetic ketoacidosis (DKA) has been recognized as a devastating and severe complication of diabetes mellitus. It is a potentially fatal emergency disease and is characterized by a biochemical triad of hyperglycemia, acidosis, and ketone bodies. [1, 2] Diabetic ketoacidosis is commonly associated with type one diabetes mellitus. However, it has been reported to affect patients with type two diabetes mellitus, if they have persistent hyperglycemia for a long period or they are under the effect of a stressor. [3-6] It is a major community health problem associated with significantly high healthcare costs, disability, morbidity, and mortality worldwide. [7, 8]

Globally, about 422 million people are diagnosed with diabetes. The majority of patients live in low- and middle-income countries. According to the International Diabetes Federation, the true prevalence of DKA is unknown. However, in 2011, it was estimated to be around 24%. [9]

DKA is responsible for more than 500,000 hospital days per year and costs an estimated 2.4 billion dollars. [10, 11] In Africa, Institution-based studies show that DKA is a major cause of disability, morbidity, and mortality and accounts for 0.6 to 24.1% of poor treatment outcomes in studies conducted in Tanzania and Libya. [12, 13] Likewise, in Ethiopia, DKA-related poor treatment outcomes range from 4.4 to 15.1%. [14-16]

Diabetic ketoacidosis is one of the most public health challenges, which is often associated with a high number of emergency visits, intensive care unit admissions, disability, shortened life expectancy, and excessive healthcare expenses in all societies (17). According to studies conducted worldwide, several factors have been reported. These are older age, inadequate insulin therapy, smoking, greater than 6 liters of fluid replacement within 24 hours, duration of diabetic mellitus greater than five years, having had chronic kidney disease, infection, severe hypokalemia, and frequency of DKA per year among the most common identified associated factors. On the other hand, potassium replacement, insulin administration greater than 60 international units, and the use of a comorbidity drug (metronidazole) with other concurrent medications contribute to good treatment outcomes in DKA. [1, 3, 14, 15, 18-20)

Diabetic Ketoacidosis management requires a multidisciplinary approach. Previous studies have established that for effective treatment of diabetic ketoacidosis, it is necessary to prevent associated morbidity, disability, and mortality. Effective treatment of DKA involved rapid restoration of adequate circulation and perfusion with isotonic intravenous fluids and correction of depleted electrolyte levels. Similarly, insulin reverses ketosis and hyperglycemia. In addition, regular monitoring of clinical signs and laboratory tests is necessary to detect and treat complications. [10, 21)

Although studies were conducted in Ethiopia, they were single-center studies, and factors such as health insurance, anemia, and renal function tests were not addressed. It makes it difficult for healthcare workers and policymakers to enhance healthcare and prevent poor treatment outcomes. Based on my best search, no similar study has been undertaken to date in the study areas.

Therefore, this study aimed to assess treatment outcomes and associated factors among adult patients with diabetic ketoacidosis admitted to the Emergency Department at comprehensive specialized hospitals in northwest Amhara, Ethiopia

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2. Methods and Materials

Study design and setting

A multicenter, institution-based, retrospective, cross-sectional study design was used from May 14, 2017, to May 15, 2022, in five Northwest Amhara regional referral hospitals, including the University of Gondar and Tibebe Ghion comprehensive specialized teaching hospitals, and the comprehensive specialized hospitals of Felege Hiwot, Debre Markos, and Debre Tabor. In these hospitals, the emergency department is equipped with noninvasive hemodynamic monitoring devices, ECG, defibrillators, and infusion pumps. Moreover, nurses, general practitioners, residents, neurologists, and other professionals work in the emergency department, where the nurse-to-patient ratio ranges from 1:4 to 1:7.

Population and sampling

The source population for this study comprised all adult patients with diabetic ketoacidosis admitted to the Emergency Departments of Amhara Regional Referral Hospitals during the study period. The study population consisted of all adult patients with diabetic ketoacidosis who were admitted and managed in the Emergency Departments of these referral hospitals from May 14, 2017, to May 15, 2022.By using a systematic random sampling technique, adult DKA patients (aged ≥18 years) treated in the emergency department at comprehensive specialized hospitals in northwest Amhara, Ethiopia, for at least five years were included, and DKA patients referred to other institutions due to different reasons, and charts with missed outcome variables or date of outcome variables were excluded.

The Sample size calculation for the second objective was performed using Epi Info Stat Cal Software, considering different factors from Shashemenie [15] and the following assumptions. Confidence level (Za/2) = 95%, Margin of error (d2) = 0.05, and Power (ZB) = 80%. Accordingly, the minimum sample size was 495, considering 10% incomplete data. Finally, 450 patient charts that fulfilled the inclusion criteria were included in the analysis.

Variables of the study

The dependent variable was the Treatment Outcome of DKA (poor, good), whereas the independent variables were Socio-demographic variables (sex, age, residence, and health insurance), Clinical variables(duration with DM, the complication of DM, DM Comorbidity, type of diabetes, type of DM treatment at admission, precipitating factor of DKA, complications of DKA, vital signs, signs, and symptoms of DKA, and severity of DKA), Baseline laboratory variables (Random blood glucose, urine PH, Urinary ketones, renal function test, Serum sodium, Serum potassium, WBC count, RBC count, Hemoglobin, and Platelets), Treatment protocol variables (Type of IV fluid bolus, Type of fluid maintenance, Total fluid replacement in the first 24 hours, Insulin dose in the first 24 hours, time taken to be DKA free, Potassium replacement, and Admitted to ICU)

DKA was defined as those patients with hyperglycemia (>13.9mmol/L (>250mg/dl)), pH < 7.3 or bicarbonate <18mmol/L, urine dipstick ketone level ≥ +1(21-23). It is classified as Mild DKA (plasma blood glucose >250mg/dl, PH 7.25-7.3or bicarbonate 15-18mmol/L, and urine ketone positive (1+) (24)), Moderate DKA (plasma blood glucose >250mg/dl, PH 7-7.24or bicarbonate 10-15mmol/L, and urine ketone positive (+2) (24)) and Sever DKA(plasma blood glucose >250mg/dl, PH <7or bicarbonate <10mmol/L, urine ketone positive (3+), and mental status is stupor/coma

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(24)). A good treatment outcome was defined as patients who showed improvement at discharge with euglycemia (70–180 mg/dl), urine pH>7.3 or bicarbonate level >18mg/dl, and ketone body-free. [17, 36] Poor treatment outcome was defined as patients who not show improvement with the left against medical advice, died in the hospital, and survived with disability [14, 15], and an adult patient was defined as patient aged ≥ 18 years. [25]

Data collection procedure and quality control

All relevant data were collected retrospectively from the patient's chart. The questionnaire was adapted from the different literature (14-16, 20). The data were extracted from the registration book and patient charts.

The data collection tool was tested on 5% of the total sample size (23 patient charts) at the University of Gondar specialized teaching hospital to ensure the availability of variables on the patient's chart, and its Cronbach's alpha result was 0.747. Before data collection, the relevance of the variables in the instrument was verified by consulting the experts working in the emergency department. The data were collected by 5 trained BSc Nurses and 2 MSc nurse supervisors, who were trained for 1 day before the study to ensure a common understanding of the data collection process. Daily communication was made between the principal investigator, the supervisor, and the data collectors throughout the data collection period. The collected data were reviewed for accuracy, completeness, clarity, and consistency before being exported into the data analysis software. Data cleaning was checked for any missing values and data errors.

Data processing and analysis

Data were entered into EpiData version 4.6 and exported to SPSS version 20 for analysis. Descriptive statistics were used to summarize the result using a table, graph, and percentage for frequency, mean with standard deviation (SD) for normally distributed data, and median with interquartile range (IQR) for skewed distributions/outliers whereas categorical variables were expressed by proportions, chi-square test was used to determine adequate cell counts for each categorical variable, model fitness test was checked by using Hosmer-Lemeshow test statistics (p=0.584) and variance inflation factor was used to assess the multicollinearity. Binary logistic regression models were fitted to identify associated factors with treatment outcomes. Factors that were statistically significant in bivariable logistic regression at p-values of 0.25 or less were carried over to multivariable logistic regression. An adjusted odds ratio with 95% CI was computed, and statistical significance was declared at p<0.05.

3. Result

Description of study participants

About 2830 adult DKA patients admitted to Emergency were treated between May 14, 2017, and May 15, 2022, in northwest Amhara referral hospitals. Based on our sample size determination, 490 medical charts were included, of which 40 were excluded due to missing charts or incomplete outcome variables.

Socio-demographic characteristics of Diabetic ketoacidosis patients

The response rate of this study was 450(91%). Among study participants, 235(52.5%) were males. The median age of the study participants was 31, with an IQR of 24-41 years. Regarding residency, 148(32.89%) of the study participants were rural dwellers. On the other hand,

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186(41.33%) of the study participants didn't have health insurance (Table 1).

Table 1. Socio-demographic Profile of Adult Diabetic Ketoacidosis Patients at Emergency Departments of Comprehensive Specialized Hospitals, Northwest Amhara, Ethiopia, 2022 (N = 450)

Variables	Frequency	Percent
Sex		
Male	215	47.8
Female	235	52.2
Age (years)		
18–30	223	49.6
31–40	105	23.3
41–50	94	20.9
>51	28	6.2
Residence		
Rural	148	32.9
Urban	302	67.1
Health insurance		
Yes	264	58.7
No	186	41.3

Clinical factors of DKA patients

Out of the study participants, 424(94.2%) had type 1 diabetes mellitus. More than half (54.2%) of the respondents had a duration of diabetes mellitus of less than 1 year, and 287 (63.8%) participants were on insulin treatment. Regarding diabetic complications, 76(16.9%) had one or more of the chronic complications of DM. On the other hand, the majority of participants (67.3%) had one episode of diabetic ketoacidosis per year. The main reasons for recurrent diabetic ketoacidosis were inappropriate insulin therapy (48%), followed by Infection/sepsis of any origin (26.9%). Most of the study participants, 366 (81.33%), presented with polyuria/polydipsia. More than half of the study participants (56.22%) experienced signs of dehydration (Table 2).

Table 2 Clinical factors among adult DKA patients admitted to Emergency department at comprehensive specialized hospitals northwest Amhara, Ethiopia2022 (N=450).

Variable	Category	Frequency (n)	Percentage (%)
Types of diabetes	Type-1	424	94.2
	Type-2	26	5.8
Duration of DM since diagnosis	<1 year	244	54.2
	1–5 years	143	31.8
	>5 years	63	14.0
Type of DM treatment at admission	Oral antidiabetic only	8	1.8
	Injectable/Insulin only	287	63.8
	Both oral and insulin	47	10.4
	Not on treatment	108	24.0
Retinopathy	Yes	76	16.9
	No	374	83.1
Foot ulcer	Yes	27	6.0
	No	423	94.0

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Stroke	Yes	5	1.1
	No	445	98.9
Ischemic heart disease	Yes	6	1.3
	No	444	98.7
Variable	Category	Frequency (n)	Percentage (%)
Frequency of DKA attack per year	Once	303	67.3
	Twice	77	17.1
	≥ three times	70	15.6
Precipitating factor of DKA	Infection	121	26.9
	Inappropriate insulin therapy	216	48.0
	Newly diagnosed DM	113	25.1
Vital sign	**Mean ± SD**		
SBP	110.53 ± 20.26 mmHg		
DBP	71.96 ± 12.17 mmHg		
PR	91.06 ± 15.87 beats/min		
RR	22.67 ± 4.36 breaths/min		
Temperature	36.296 ± 0.77 °C		

Other symptoms include: Loss of appetite, Fatigability, Headache, weight loss

Comorbidity of DM

Of a total of 450 patients, 75 (16.67%) had a comorbidity of DM; of which hypertension was 42(9.33%) and heart disease 13(2.89%) were the most common (figure 1).

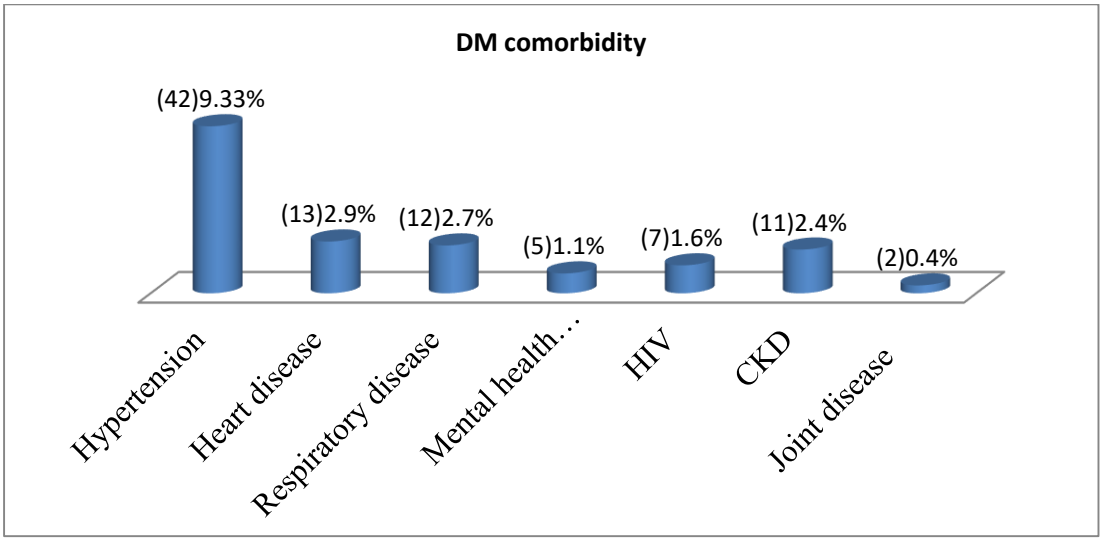

Figure 1: Comorbidity of DM patients admitted to Emergency department

Complications of DKA patients: From a total of 450 patients, 77 (17.11%) had DKA complications; of which shock 23(5.1%), hypokalemia 22(4.9%), and acute kidney injury 17(3.8) were the most common complications (Figure 2).

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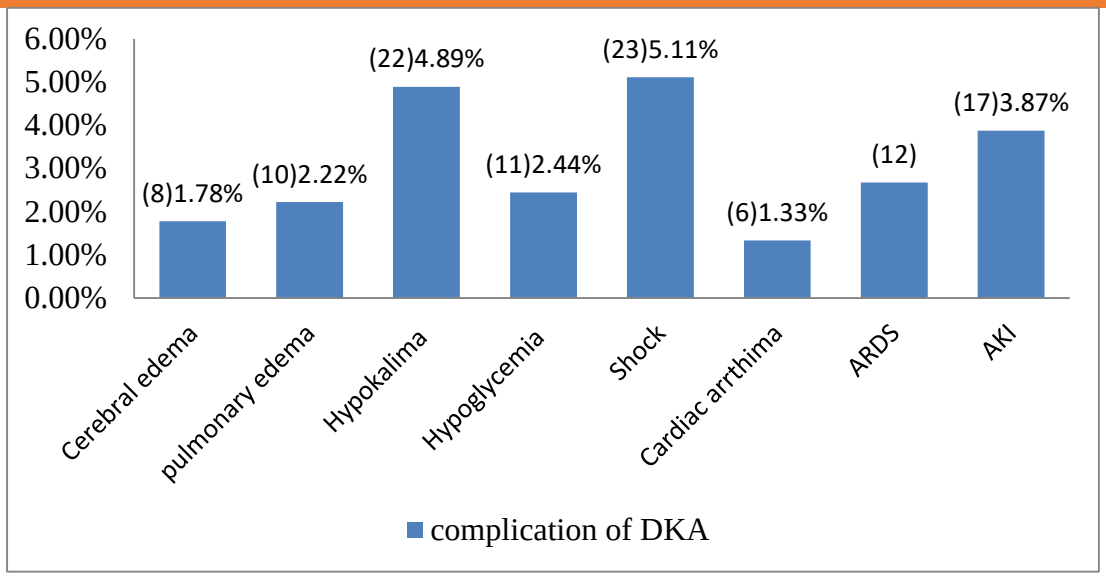

Figure 2: Complication of DKA patients admitted to Emergency department

Baseline laboratory factors

The mean with a standard deviation of random blood glucose was 452.3±101.9 mg/dl, Serum creatinine (0.9±1.2), Serum sodium (137.4±6.4 meq/l), Serum potassium (3.9±0.8 meq/l), Hemoglobin (13.4±2.9 g/dl), RBC count (5.3 ± 6.9), respectively. The median with an interquartile range of WBC count was 7.396(4.8-8.8), PH 7(6-7), Serum urea 21(16.2-26) mg/dl, and Platelets 230(173-286) microliter respectively (Table 3).

Table 3: Baseline laboratory factors of adult DKA patients admitted to Emergency department at comprehensive specialized hospitals northwest Amhara, Ethiopia2022 (N=450).

Variables	Categories	Frequency	Percent
Urinary ketones	1+	125	27.8
	2+	126	28.0
	3+ and above	199	44.2
PH	7.25-7.3	125	27.8
	7-7.24	126	28.0
	<7	199	44.2
Serum creatinine level	Normal	211	46.9
	Low	190	42.2
	High	49	10.9
Serum urea level(mg/dl)	Normal	202	44.9
	Low	2	0.4
	High	246	54.7
Serum potassium (mEq/L)	Normal	307	68.2
	Hypokalemia		126

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	Hyperkalemia	17	3.8
Serum sodium (mmol/L)	Normal	224	49.8
	Hypernatremia	188	41.8
	Hypernatremia	38	8.4
WBC count(x109/L)	normal	289	64.2
	Low	96	21.3
	High	65	14.4
Hemoglobin (g/dl)	Non anemic	401	89.1
	Anemic	49	10.9
Platelet count (microliter)	Normal	377	83.8
	Thrombocytopenia	57	12.7
	Thrombocytosis	16	3.6

Severity of DKA

Patients admitted to the emergency department at Northwest of Amhara comprehensive specialized hospitals who were found to have severe, moderate, and mild DKA were 44.2%, 28%, and 27.8%, respectively (Figure 3).

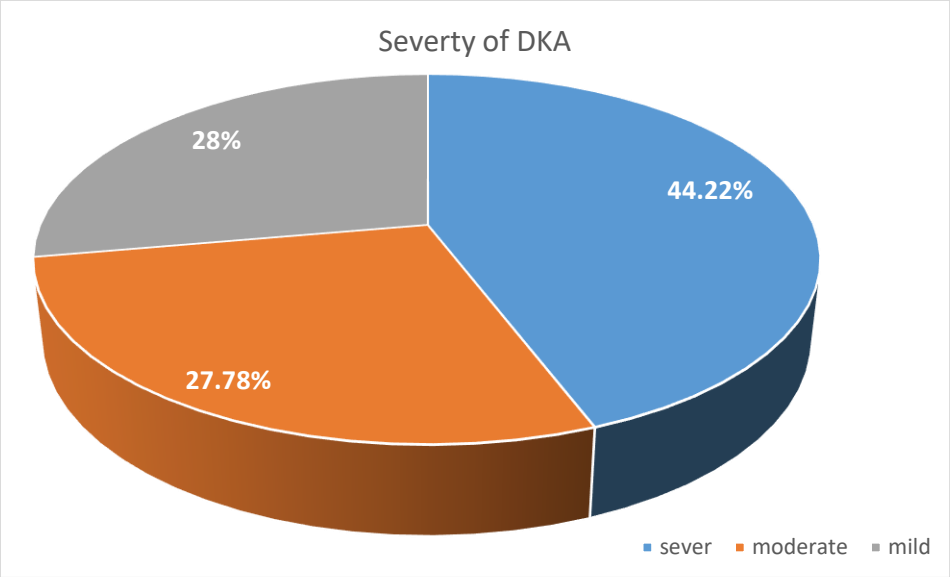

Figure 3: Severity of DKA episode adult patients admitted to Emergency department

Treatment protocol among adult Diabetic ketoacidosis patients

Regarding management protocol, the most commonly used fluid was normal saline (92%). The Total fluid replacements in the 1st 24 hours of less than 3 liters were 21.8%, and greater than 6 liters were 45.76%, with an average amount and standard deviation of fluid of 7±6.174 liters. Greater than 60IU insulin administered in the first 24 hours was 46% with a mean and standard deviation of 48.22±18.966 IU. In addition, Potassium chloride replacement was 70%. Moreover, patients free from DKA for less than 24 hours were

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37.55% with a mean and standard deviation of 45.69±26.72hrs. Patients admitted to the ICU were 8% (Table 4).

Table 4: Treatment protocol among adult DKA patients admitted to Emergency department at comprehensive specialized hospitals northwest Amhara, Ethiopia2022 (N=450).

Variables	Categories	Categories	Frequency	Frequency	Percent
Type of IV fluid bolus given	NS	NS	411	411	91.3
	RL	RL	5	5	1.1
	Not given	Not given	34	34	7.6
Type of fluid mainte-nance used	Type of fluid maintenance used	Type of fluid maintenance used	Type of fluid maintenance used	Type of fluid maintenance used	Type of fluid maintenance used
Normal saline	Yes	414	414	92.0	92.0
	No	36	36	8.0	8.0
Ringer lactate	Yes	20	20	4.4	4.4
	No	430	430	95.6	95.6
Dextrose 5% in water	Yes	36	36	8.0	8.0
	No	414	414	92.0	92.0
Dextrose normal saline	Yes	80	80	17.8	17.8
	No	370	370	82.2	82.2
Total fluid replacement in the 1st 24 hours	≤3Liters	98	98	21.8	21.8
	3-6Liters	145	145	32.2	32.2
Total fluid replacement in the 1st 24 hours	>6Liters	206	206	45.8	45.8
	<40IU	190	190	42.2	42.2
	40-60IU	153	153	34.0	34.0

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Total regular insulin dose in the first 24 hours	>60IU	207	207	46.0	46.0
Did Potassium replacement done when <5.5meq/l	Yes	315	315	70.0	70.0
	No	135	135	30.0	30.0
Time to free from DKA	<24hour	170	170	37.8	37.8
	24-72hour	168	168	37.3	37.3
	>72hour	112	112	24.9	24.9
Was the patient Admitted to ICU	Yes	36	36	8.0	8.0
	No	414	414	92.0	92.0

ICU: intensive care unit, NS: Normal saline, RL: Ringer lactate, IU: international unit

The proportion of the treatment outcome

The overall poor treatment outcome of adult DKA patients admitted to the emergency department at Northwest of Amhara National Regional State comprehensive specialized hospitals was 5.1% (95% CI: 3.3% - 7.6%) (Figure 4).

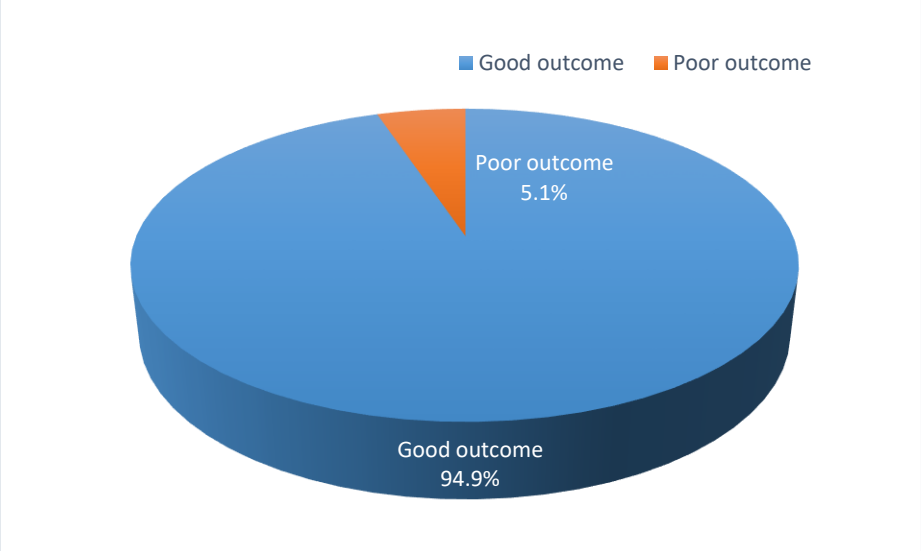

Figure 4: Treatment outcome of adult Diabetic ketoacidosis patients admitted to Emergency department

Factors associated with poor treatment outcome

The bivariable analysis results show that place of residency, health Insurance, fluid replacement, potassium replacement, time to free from DKA, and total regular insulin were factors associated with poor treatment outcome of DKA at p-values <0.25.

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However, in multivariable logistic regression analysis, health insurance, fluid replacement, potassium replacement, and time to be free of DKA were found to be statistically significantly associated with poor DKA treatment outcomes (p <). Accordingly, the odds of poor treatment outcomes in DKA were 3.2 times higher (AOR=3.23; 95% CI: 1.14-9.13) among adult DKA patients who did not use medical insurance compared with those who did. Similarly, patients who received less than 3 liters of fluid replacement in the first 24 hours had 3.9 times (AOR=3.86; 95% CI:1.17-12.72) the odds of poor treatment outcomes among adult DKA patients as compared to those who received greater than 6 liters of fluid replacement. Likewise, the odds of poor treatment outcomes among adult DKA patients who did not receive potassium replacement were 3.8 times higher (AOR=3.84; 95% CI: 1.44-10.22) than among those who did. Moreover, DKA patients who remained DKA-free for> 72 hours had 3.9 times (AOR=3.93; 95% CI: 1.31-11.81) the odds of poor treatment outcomes compared with those who remained DKA-free for < 24 hours (Table 5).

Table 5: Logistic regression analysis of factors associated with treatment outcome among adult Diabetic ketoacidosis patients admitted to Emergency department at comprehensive specialized hospitals northwest Amhara, Ethiopia2022 (N=450).

Variables	Categories	Poor (n=23)	Good (n=427)	COR (95%CI)	P-value	AOR (95%CI)	P-value
Residence	**Rural**	13	135	2.81(1.20-6.57)	0.017*	2.52(0.97-6.53)	0.058
	Urban	10	292	1		1	
Having Insurance	**No**	17	169	4.33(1.67-11.19)	0.003*	3.23(1.14-9.13)	0.027*
	Yes	6	258	1		1	
Fluid replacement	**<3Liters**	11	87	4.24(1.518-11.82)	0.006*	3.86(1.17-12.72)	0.026*
	3-6Liters	6	139	1.45(0.457-4.58)	0.530	0.88(0.240-3.22)	0.846
	>6Liters	6	201	1		1	
Total regular insulin	**<40IU**	17	173	3.41(0.975-11.91)	0.055*	3.41(0.821-14.17)	0.091
	40-60IU	3	150	0.69(0.14-3.50)	0.658	0.760(0.135-4.29)	0.756
	>60IU	3	104	1		1	
Potassium replacement	**No**	15	120	4.80(1.98-11.61)	0.001*	3.84(1.44-10.22)	0.007*
	Yes	8	307	1		1	
Time to DKA free	**>72hour**	13	99	3.05(1.17-7.88)	0.022*	3.93(1.31-11.81)	0.015*

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	24-72hour	3	165	0.418(0.106-1.65)	0.212*	0.54(0.12-2.34)	0.409
	<24hour	7	163	1		1	

COR-crud odds ratio, AOR-adjusted odds ratio, CI-confidence interval

4. Discussion

This study found that the proportion of poor treatment outcomes among adult patients with diabetic ketoacidosis treated at the northwest Amhara comprehensive specialized hospitals was 5.1% (95% CI: 3.3%-7.6%). This study was in line with the study conducted in Thailand [26] and Debre Tabor. [16] In Thailand, the possible explanation is the similarity between the study design and sampling technique. While in Debre tabor, the similarity of study setting, socio-economic status, health care delivery system, study design, and sampling technique were the main reasons.

However, higher than the studies done in Saudi Arabia (20) and Libya. [12] The reason for this discrepancy could be differences in treatment protocols (they lacked unified protocols), sample size, population characteristics, and the quality of healthcare services. [12, 20] This may lower the proportion of poor treatment outcomes.

In contrast, this finding was lower than those reported in studies conducted in South Africa, Malaysia [27], Damascus [19], Tanzania [13], Adama [14], and Shashemenie. [15] Possible reasons for this inconsistency include differences in study design, study period, study population, and the socio-demographic characteristics of the study participants. In Damascus, the study population was >12 years old, whereas in Tanzania, there were all age groups. Adama and Shashemenie used a single-centered study area and lacked routine electrolyte tests (serum potassium). This may increase the proportion of poor treatment outcomes.

This study was the first to see the association between health insurance and treatment outcomes among adult DKA patients. In the present study, lack of health insurance was significantly associated with poorer treatment outcomes among adult DKA patients. The odds of having poor treatment outcomes of DKA were 3.2 times higher among those who didn't have health insurance than among patients who had health insurance. The possible explanation is that the rising cost of healthcare can be managed with a health insurance plan that covers costs associated with care, hospitalization, a free health checkup, and pre- and post-hospitalization charges (28). But a lack of health insurance reduces access to recommended care, results in poorer-quality care, and leads to worse health outcomes than among insured adults. [29]

In this study, total fluid replacement in the 1st 24 hours was associated with poor treatment outcomes among adult DKA patients. Patients who received less than 3 liters of fluid replacement in the first 24 hours had 3.9 times the odds of poor treatment outcomes compared with those who received more than 6 liters. This study was supported by the WHO Diabetes guideline (30) and a study conducted in Adama. [14] A possible reason could be the loss of 6 to 9 L of body fluid due to the large amount of glucose entering the renal tubules, which pulls a large amount of water. This causes the kidneys to produce a large amount of urine and leads to dehydration, volume depletion, hypovolemic shock, and death. Therefore, replacing approximately half of the total volume lost during the first 8 to 12 hours

and the remaining within 24 to 36 hours is necessary for tissue perfusion and resolution of the associated metabolic abnormalities. [21, 31]

This study also found that potassium replacement was significantly associated with poor treatment outcomes among adult DKA patients. The odds of poor treatment outcomes among adult DKA patients who didn't receive potassium replacement were 3.8 times higher than among those who did. This study was supported by a study conducted in Adama. [14] Possible reasons include a lack of potassium testing, a shortage of KCL, inappropriate potassium supplementation, and the use of insulin, all of which can cause potassium to move intracellularly and result in hypokalemia. [32] Hypokalemia in patients with DKA is the most common electrolyte imbalance due to renal loss and intracellular shift secondary to insulin effect, correction of acidosis, and fluid therapy volume expansion, which decreases serum potassium concentrations. [33] It has a significant impact on neuromuscular and cardiopulmonary systems, which predisposes patients to respiratory failure, cardiac arrhythmias, and potentially death. [30]

Moreover, the time to DKA freedom was significantly associated with poor treatment outcomes. DKA patients who remained> 72 hours to be DKA-free had 3.9 times the odds of poor treatment outcomes compared with those who remained < 24 hours. It was supported by a Saudi Arabian study (20). This is supported by studies showing that patients who took >72 hours to be DKA-free had higher rates of nosocomial infections and complications. [34, 35]

The limitation of the study was that it was conducted using secondary data; sociodemographic data (income, educational status, marital status, and Occupation) and crucial laboratory test results (such as bicarbonate) were left out, and it also didn't address behavioral characteristics like smoking and alcohol.

5. Conclusion

The Proportion of poor treatment outcomes among adult DKA patients in this study was lower than in previous studies. Not having health insurance, fluid replacement (< 3 liters), not replacing potassium, and time to recover from DKA (> 72 hours) were associated with poor treatment outcomes of diabetic ketoacidosis.

Abbreviations

AKI: Acute Kidney Injury
AOR: Adjusted Odds Ratio
ARDS: Acute Respiratory Distress Syndrome
BSC: Bachelor of Science
BUN: Blood Urea Nitrogen
CI: Confidence Interval
CKD: Chronic Kidney Disease
DKA: Diabetic Ketoacidosis
HTN: Hypertension
IDF: International Diabetic Federation
MSc: Master of Science
SPSS: Statistical Package for Social Science
USD: United States Dollar
WHO: World Health Organization

Author Contributions

Data collection, formal analysis, fund acquisition, resources, software, validation, visualization, the investigation, methodology, supervision, conceptualization, analysis, and interpretation of writing a detailed review, editing, and preparing manuscript: ZGR, MGA, MGH, CDA, GBR. Finally, all the authors have approved the manuscript for submission.

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Competing interests

All authors declare that they have no competing interests in the final content of the manuscript.

Data Availability

Upon reasonable request, you can obtain the data used for the current analysis from the corresponding Author.

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Case Report

Pan African Journal of Emergency and Critical Care (PAJEC)

Subdural hematoma in a patient with cerebral malaria - Diagnostic dilemma in the emergency department of a resource-limited setting

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Keywords: Malaria, Subdural hematoma, Emergency Department

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ABSTRACT

Background: *Malaria is still endemic in most African countries, making it a significant threat to global public health. Here, we describe a patient with malaria having a massive subdural hematoma.*

Case: *The case reports a 17-year-old male who presented with severe malaria after he presented with a two-week history of headache, generalized body malaise, high-grade fever, followed by one day of generalized tonic-clonic seizure and loss of consciousness. After the patient recovered, he reported that he had trauma 2 weeks prior to the above symptoms. Urgent CT of the brain showed a massive subdural hematoma, which requires referral to a referral hospital where an operation was performed. After 3 weeks, the patient is fully awake and at his baseline neurological function.*

Conclusion: *This case demonstrated the diagnostic challenge in the emergency room, since the reduced level of mentation and convulsion may be explained solely by cerebral malaria, but deciding and doing a brain CT revealed a subdural hematoma that improved with surgery. What if the subdural was overlooked in a resource-limited context, without imaging, and without a decision to image? Malaria would be the cause of death, correct?*

Citation: *Ayalew Zewdie, Biruktawit Zemedie Lemma, Valentine Byiringiro. Subdural hematoma in a patient with Cerebral malaria - Diagnostic dilemma in the emergency department of a resource-limited setting. PAJEC.2026; 4(1): Page number 27-30.*

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1. Introduction

Malaria is a fatal illness spread by mosquitoes that kills over 500,000 people worldwide each year. It is a chronic and serious public health concern because of its disproportionate effect on vulnerable groups. [1,2]

Cerebral malaria is a life-threatening consequence of Plasmodium falciparum infection. Patients manifest with the classic triad of high fever, convulsions, and coma because of parasites sequestering in brain capillaries. It is a medical emergency with a high fatality rate and long-term brain impairments in survivors.

A subdural hematoma is a serious condition in which blood accumulates between the dura mater and the arachnoid membrane, believed to result from slow venous bleeding, typically from bridging veins on the cerebral surface, leading to an altered level of consciousness and convulsions. [3]

We present a rare presentation of a patient with severe malaria found to have a massive subdural hematoma because of the rare presentation of malaria with SDH, and the diagnosis of SDH in patients with malaria is often missed.

2. Case report

We present a case of a 17-year-old male who was admitted to our facility with a history of convulsions, which were generalized tonic clonic, which occurred 2 times, lasting less than 5 min during the day of presentation. For the past week before admission, he had a headache, generalized body malaise, high-grade fever, and vomiting of ingested matter. He has no trauma history.

This was the patient's first admission. There are no known chronic illnesses, and there is no personal or family history of coagulopathies. The patient has no history of smoking or alcohol consumption.

Upon arrival to ED, his Vital signs were Blood pressure (BP) of 158/83, Pulse Rate of 88, Respiratory rate of 20, and oxygen saturation of 97%. The general physical exam was unremarkable. The neurological examination revealed a Glasgow Coma Scale score of 13/15 (Eye – 3, Motor – 6, Verbal – 4). There was neck stiffness, but no other signs of meningeal irritation or neurological deficits were observed. Laboratory findings werewbc-13.14(4-10), hemoglobin 14.5(12-18), platelet 352k (150k-450k), Sodium 135(135-145), Potassium 3.9(3.5-5), chloride 97.7 (98-107), Urea 2.8(), creatinine 48 (44-115). SGOT10.9 (5-34), SGPT 9.1(0-55). Malaria thick smear showed +++ trophozoite. The positive malaria smear test almost led the team to 'premature closure' of the diagnostic process. During the round, it was decided to do a brain CT scan. A CT scan of the head revealed a right subdural hematoma with mass effect as figure 1.Upon arrival to the Emergency Department, the patient was initiated on intravenous artesunate (2.4 mg/kg), ceftriaxone (1 gm IV), a loading dose of phenytoin (20 mg/kg), and paracetamol (1 gm IV), in addition to comprehensive supportive care.

He was transferred to a referral hospital for neurosurgical care, where a bur hole was done, and the hematoma was drained. When the patient awoke, he stated that he had fallen one week prior to the current presentation. He returned home after a three-day hospital stay.

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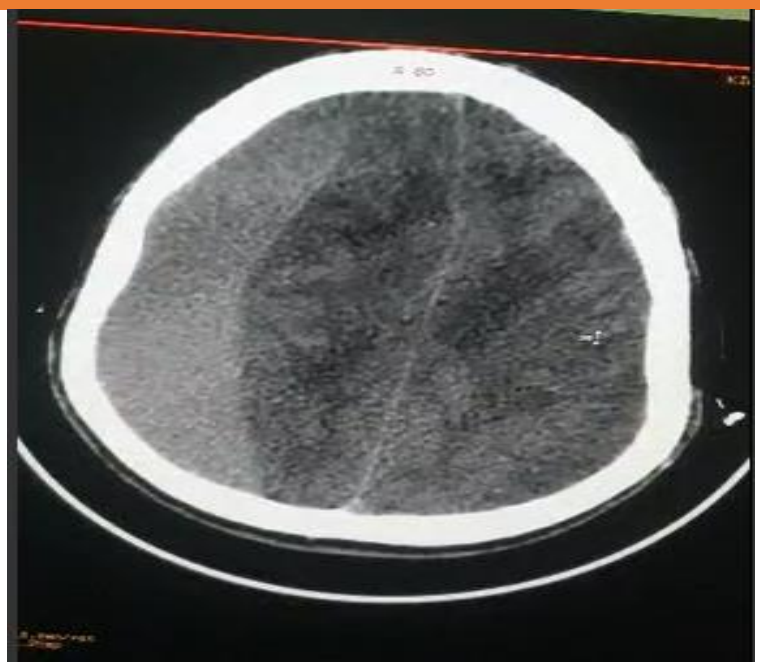

Figure 1: Right side acute massive subdural hematoma with midline shift

3. Discussion

Cerebral malaria, a severe complication, involves CNS manifestations such as convulsions, hemiplegia, delirium, coma, and often death. [4] Subdural hematomas mostly happen post-trauma because of torn veins. Some of the causes of SDH were head trauma, antithrombotic medication use, and high altitude. (5-8)

There were reports of patients having spontaneous subdural hematoma after having malaria. (8-12)

This scenario demonstrates a key diagnostic challenge in resource-constrained contexts. In a resource-limited setting, the patient's presentation is typically considered to be due to malaria or meningitis because of epidemiologic factors and the lack of imaging. The clinical presentation looks like cerebral malaria initially, but a CT scan revealed a subdural hematoma, necessitating immediate neurosurgery. Without early imaging and making decisions to image, the patient could have lost his life, and fatality would have been misclassified as malaria, which underlines the critical need for diagnostic skills and decision-making in the emergency department.

The patient could have minimal SDH after the trauma, which was neglected because he did not go to a health facility, which could have been worsened by malaria, causing systemic inflammation. Even though the platelet cunt is normal, it could be dysfunctional and could have worsened the bleed.

This case highlights the vital importance of neuroimaging in patients presenting with an unexplained altered mental state, even if a solid primary diagnosis, such as cerebral malaria, is suspected. It emphasizes the critical need to maintain a broad differential diagnosis and remain vigilant in high-volume emergency situations to avoid missing life-threatening conditions.(13-15) Clinicians must actively screen for simultaneous, life-threatening illnesses such as traumatic cerebral hemorrhage rather than relying too much on a single, first reasonable explanation.

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4. Conclusion

This case highlights the importance of thorough assessment, critical decision-making, and diagnostic imaging to identify life-threatening illnesses in emergency departments in limited-resource settings.

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Competing interests

The authors declare no conflicts of interest.

Author contribution

All authors are involved in conceptualization, data curation, initial write up, final editing and review.

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Case Report

Pan African Journal of Emergency and Critical Care (PAJEC)

Management of STEMI with Complete Heart Block Using Transcutaneous Pacing: Case Report

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ABSTRACT

Background: *Transcutaneous cardiac pacing is a rapid, non-invasive method for stimulating the heart through skin electrodes and is vital in managing life-threatening Bradyarrhythmia. This case report highlights its role in a patient with severe arrhythmia following myocardial infarction.*

Case Presentation: *A 53-year-old male presented to the emergency department with chest pain. His condition progressed from STEMI to a third-degree atrioventricular (AV) block, which led to cardiac arrest. Transcutaneous pacing stabilized the patient, allowing time for coronary intervention. Following revascularization, the AV block resolved completely, and the patient recovered without residual conduction disturbances.*

Conclusion: *Prompt recognition and management of third-degree AV block in patients with ST-elevation myocardial infarction is essential. Emergency transcutaneous pacing, followed by timely coronary intervention, can be life-saving and restore normal cardiac conduction.*

Keywords: case report, third-degree AV block, transcutaneous pacing, PCI, STEMI

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1. Introduction

Ischemic heart disease is the root cause of about 40% of all AV blocks. Both acute and chronic ischemic heart disease may result in the development of an AV block, with rates of high-degree AV block ranging from 2.7% to 14.0%. Conduction blocks in the presence of anterior myocardial infarction are less frequent but are associated with a worse prognosis. [(1)]

Severe circulatory failure that causes substantial in-hospital mortality, associated morbidity, and financial burden is known as cardiogenic shock. Atrial and ventricular arrhythmias are most likely to occur in patients experiencing cardiogenic shock. [(2)]

Two potentially fatal consequences of acute ST-segment elevation myocardial infarction (STEMI) are ventricular tachycardia (VT) and ventricular fibrillation (VF). Previous research indicates that 5% to 10% of individuals with acute STEMI experience VT, with two-thirds of instances occurring before reperfusion and 90% during the first 48 hours following infarction. [(3)]

In general, the presence of a high-degree complete (A-V) block in acute myocardial infarction is reported at 1.5-13%. Acute myocardial infarction complicated by A-V block has a much higher predictor of mortality rates than cases without block. [(4)]

2. Case report

A 53-year-old male hypertensive patient from Addis Ababa on medical management presented to our hospital's emergency department with a 48-hour history of sharp and crushing-type chest pain radiating to the left arm and jaw. The patient also had associated diaphoresis and nausea. Medical history was only significant for hypertension. Upon presentation to the ED, his blood pressure was 60/40 mmHg, pulse rate was 38 beats per minute (bpm), respiratory rate was 22 breaths/minute, body temperature was 36.0 °C, and oxygen saturation was 95% while breathing ambient air. He had cold extremities. Because of cardiogenic shock and unstable symptomatic bradycardia with hemodynamic instability, management was initiated according to adrenalin infusion. While the patient was started on an adrenaline infusion, he developed sudden cardiac arrest with asystole as the arrest rhythm. Cardiopulmonary resuscitation (CPR) was immediately initiated and continued in accordance with advanced cardiac life support guidelines. The patient underwent five episodes of cardiac arrest, and return of spontaneous circulation (ROSC) was achieved after approximately 10 minutes. Following ROSC, the blood pressure was unrecordable, and the pulse rate was 32 beats per minute. Thus, the patient was put on a transcutaneous pacemaker with a rate of 80beats/min and capture current of 40 milliampere (MA). Subsequently, the patient experienced another 3 episodes of cardiac arrest, for which CPR was done, and the capture current was escalated to 80MA, and the pacer rate was increased to 100 B/min. The patient was intubated on the second cycle of cardiac arrest and was put on Adrenaline and Noradrenaline infusion. Dobutamine was added once the BP reached to 90/60, since he was having an estimated EF OF 10-15 % with anterolateral wall akinesis. The patient was on continuous sedation with midazolam and fentanyl infusion. Concurrently, laboratory tests were conducted, and the findings are shown in Table 1.

Electrocardiogram (ECG) on admission showed ST-segment elevation in leads V1–6 (Fig. 1). Echocardiography revealed anterior wall akinesis and ejection fraction (EF) of 10-15%. He was diagnosed as having anterolateral STEMI, and management started after stabilization.
After stabilization, the patient went to the CAT-LAB (fig. 3), where Coronary angiography via right femoral approach was performed, revealing a type

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III vessel with 99.5% stenosis of the mid LAD segment, with fresh thrombus. PCI was performed, and the patient was transferred to the ICU. During follow-up at the ICU, the patient developed ventricular tachycardia twice (Fig. 2) and was successfully managed with amiodarone. After two weeks of ICU stay, the ECG became sinus rhythm, and after one week of ward stay, the patient was discharged improved with follow-up after being initiated on guideline-directed medical therapy with the diagnosis of heart failure with reduced ejection fraction. At the follow-up visit one month after discharge, the patient showed significant improvement in ejection fraction, which increased to 35-40%.

Table 1: Laboratory profile of the patient during emergency and intensive care unit care

Laboratory Test	Day 1	Day 2	Day 4	Day 7
WBC(×10³/µL)	4.5	7.6	8	6
HGB(g/dL)	13	13.1	12	14.2
BUN (mg/dL)	84	76	80	33
Creatinine (mg/dL)	2.2	2.4	2	1.2
AST (IU/L)	62	60	57	46
ALT (IU/L)	48	55	44	36
High-sensitivity Troponin (ng/mL)	>50	43	26	20

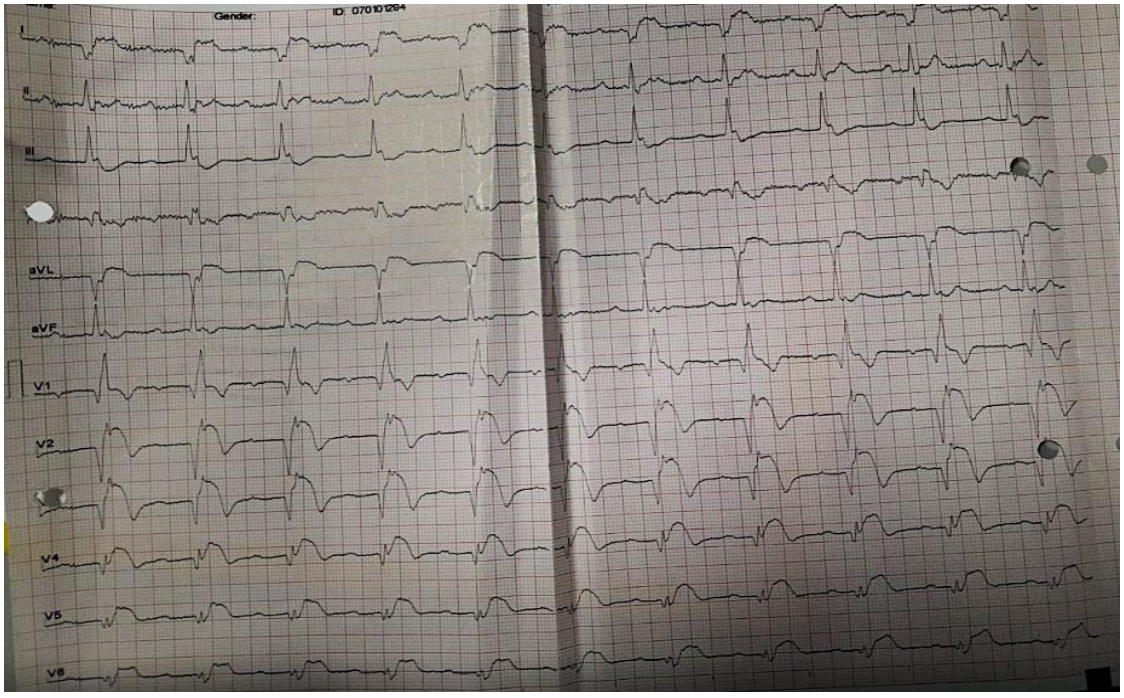

Fig 1: The patient's ECG shows anterolateral STEMI, with ST-elevations on v1-v6

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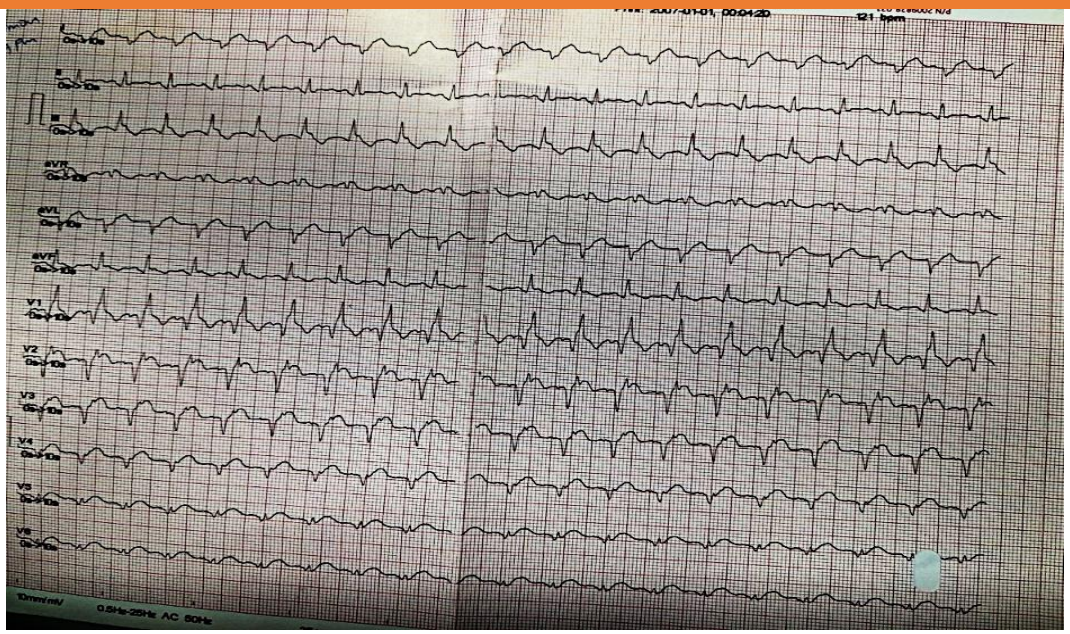

Fig 2: The patient's ECG shows ventricular tachycardia.

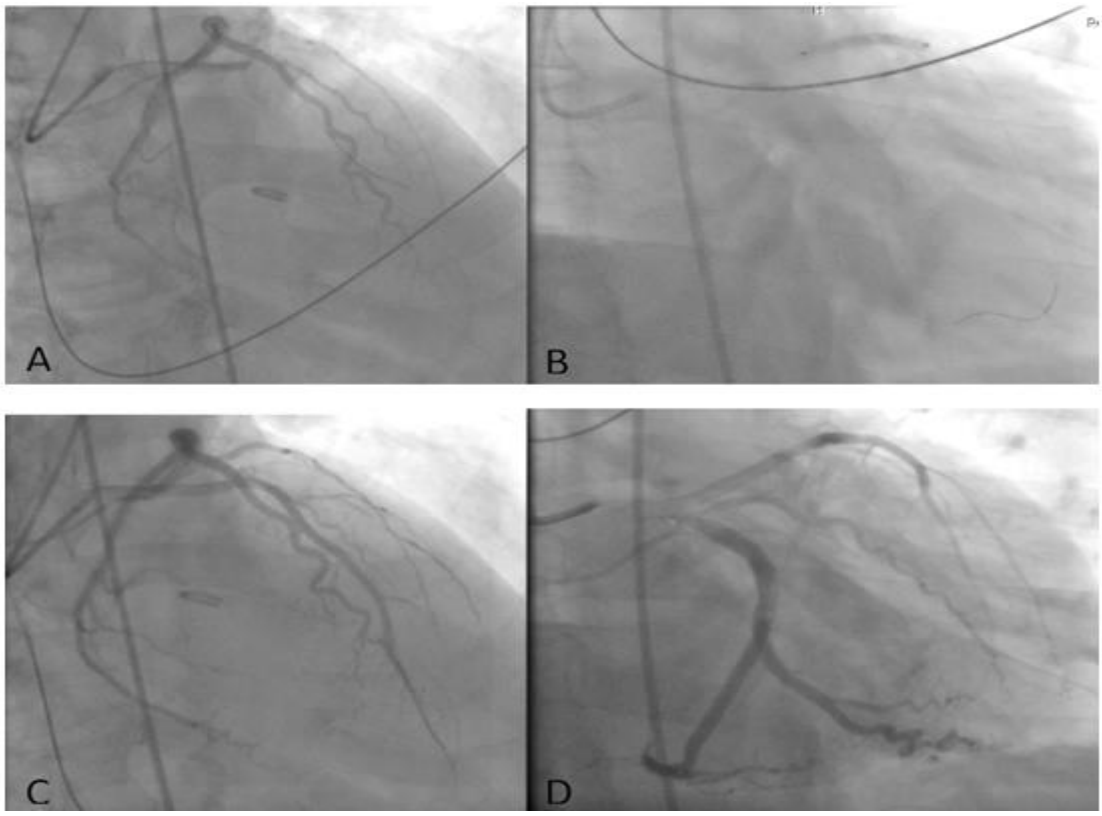

Fig 3: Left coronary angiogram: (A) Anterior-posterior (AP) cranial view showing total mid left anterior descending coronary artery occlusion and coronary wire across the lesion. (B) In the right anterior oblique (RAO) caudal view, drug-eluting stent implantation across the occluded segment. (C and D) depicted patent LAD with grade III TIMI Flow in both projection

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3. Discussion

The management of acute ST STEMI complicated by full atrioventricular (AV) block with concomitant recurrent cardiac arrest and hemodynamic instability presents a significant clinical complex. The degree of instability that required numerous resuscitations and a prolonged period on temporary pacing support highlights the severity and complexity of the case, even though the development of high-grade AV block and anterior STEMI is a known event. When a patient develops AV block in STEMI, it leads to a poor prognosis because of substantial conduction and myocardial involvement; it is more common in inferior infarctions but less common in extensive anterior infarctions. [5]

Although the patient required transvenous temporary pacing (TVP) and had received only transcutaneous pacing (TCP), current ACLS and guidelines recommend a rapid transition from TCP to TVP in cases of persistent symptomatic bradycardia, as transcutaneous pacing often fails to achieve consistent capture and is associated with pain and inadequate cardiac output. (6) Recurrent arrests suggest that resource-limited TVP equipment has contributed to persistent hemodynamic instability and disease severity.

STEMI with AV block, particularly anterior infarctions, is associated with increased morbidity and death. This case is compelling because, whereas prior research supports pacing and shows the overall occurrence of AV block in STEMI, few studies report recurrent cardiac arrests despite pacing attempts. Transient block or isolated hemodynamic compromise was treated with pacing, which accounted for the majority of cases. [7]

In a resource-limited area, TVP is underutilized. The literature shows that early pacing is associated with improved outcomes in patients with shock and conduction block. The majority of known cases improved with a single stabilization attempt, in contrast to our case, which included five distinct times of cardiac arrest, hemodynamic collapse, and progression from TCP to TVP, which was delayed because of limited resources. [8]

In many studies, increased morbidity and mortality are associated with conduction block complicating acute myocardial infarction. Acute ST-segment elevation myocardial infarction frequently leads to complete atrioventricular (AV) block. Patients with STEMI have a higher risk of developing a complete AV block than patients without STEMI. [5] To maintain cardiac output and stop the development of harmful arrhythmias, temporary pacemakers (TP) are used in patients with atrioventricular block and ST-segment elevation myocardial infarction (STEMI). [6]

Therefore, TCP is a useful therapeutic option for patients with cardiac dysrhythmia emergencies, providing temporary support for adequate cardiac output and tissue perfusion. To stabilize patients and enhance their outcomes, TCP can be started as early as possible. [7]

When emergency patients experience hemodynamically significant bradycardia, external cardiac pacing can be life-saving. Patients who respond to external pacing show a significant increase in blood pressure after its use. [9]

The case effectively demonstrates the successful implementation of transcutaneous pacing as a bridge to definitive PCI treatment, including specific technical details on pacing parameters; however, it lacks detailed information on the patient's pre-existing cardiac risk factors beyond

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hypertension, which would have provided additional context for understanding the development and progression of the condition.

4. Conclusion

This case report highlights the importance of detecting and treating third-degree AV block in STEMI patients as early as possible, and the use of transcutaneous pacing in an emergency setting for symptomatic third-degree AV block following a STEMI complication.

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Competing interests

The authors declare no conflicts of interest.

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Case Report

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Refractory unstable atrial fibrillation in a young Ethiopian patient with rheumatic heart disease: insights and challenges

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ABSTRACT

We report a case of a 28-year-old female with chronic rheumatic valvular heart disease and poor medication adherence presenting with unstable, refractory atrial fibrillation. Initial bedside point-of-care ultrasound examination demonstrated significant bi-atrial dilatation, mitral valve thickening, moderate mitral regurgitation, and severe tricuspid regurgitation. Despite multiple attempts at electrical cardioversion, the patient was not successfully cardioverted. Intravenous amiodarone was subsequently administered as a form of chemical cardioversion, leading to stabilization and successful conversion to sinus rhythm. This single case suggests that significant structural and valvular heart disease in atrial fibrillation may be a negative predictive factor for unsuccessful electrical cardioversion. In these cases, consideration should be given to chemical cardioversion with medications such as amiodarone as a potential first-line strategy over electrical cardioversion.

Keywords: atrial fibrillation, amiodarone, refractory atrial fibrillation, rheumatic heart disease

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1. Introduction

Atrial fibrillation is the most prevalent prolonged heart arrhythmia and is typified by irregular automatic firing with the existence of several interacting re-entry circuits that loop around the atria, which leads to suboptimal cardiac output. Rapid bursts of ectopic beats originating from sick atrial tissue or muscular sleeve tissue in the pulmonary veins frequently start atrial fibrillation episodes. [(1)]

Currently, rhythm and rate control medications and electrical cardioversion are the cornerstones of acute treatment. Amiodarone is the most effective medication for controlling rhythms. [(1)]

Electrical cardioversion is a safe and effective procedure in patients with tachyarrhythmias. With the procedural safety and effectiveness confirmed more than 40 years ago, it is now widely used in the management of unstable atrial fibrillation.[(2)] Here, we present a case of amiodarone's effectiveness as a pharmacologic cardioversion agent in acutely unstable atrial fibrillation with pre-existing structural and valvular heart disease.

2. Case report

A 28-year-old female with a history of chronic rheumatic valvular heart disease presented to the emergency department with one month of worsening shortness of breath, dry cough, generalized fatigue, and abdominal distension. She had recently self-discontinued her prescribed medications (furosemide 40 mg PO BID, spironolactone 25 mg PO daily, and metoprolol tartrate 25 mg PO daily) for an unspecified duration.

On presentation, her airway was patent, and she was breathing comfortably with a respiratory rate of 16 breaths per minute and oxygen saturation of 97% on room air. Supplemental oxygen at 3 L/min was initiated for patient comfort. Her blood pressure was 90/65 mmHg, and the apical heart rate was 160 beats per minute, irregularly irregular. Physical examination revealed raised jugular venous pressure, an active precordium, and a grade IV holosystolic murmur best heard at the apex and radiating to the axilla. Her abdomen was distended with a positive fluid wave test, and there was trace bilateral pedal edema.

The patient was placed on continuous cardiac monitoring, and an electrocardiogram was completed, which demonstrated atrial fibrillation with rapid ventricular response (heart rate 160–184 bpm). The patient deteriorated clinically, as subsequent vitals revealed an apical heart rate of 180 bpm, persistent hypotension (at times an undetectable blood pressure on automatic monitors), and delayed capillary refill.

Bedside point-of-care ultrasound (POCUS) was performed during ongoing resuscitation and management using a Phillips Lumify device. POCUS findings included bilateral pleural effusions and free fluid in the abdomen. Four cardiac views were obtained, including subcostal, parasternal long, parasternal short, and apical four-chamber. Cardiac POCUS demonstrated significant bi-atrial dilatation with the left atrium larger than the right atrium (Figure 1). Valvular assessment revealed mitral valve thickening (posterior leaflet greater than the anterior leaflet) (Figures 2 and 3) with a hockey stick appearance of the anterior leaflet (Figure 2). Findings were consistent with suspected mitral stenosis. Qualitative assessment with color Doppler suggested moderate mitral regurgitation (Figure 4) and severe tricuspid regurgitation (Figure 5). Overall, findings were in keeping with the patient's history of rheumatic heart disease with significant bi-atrial dilatation as described.

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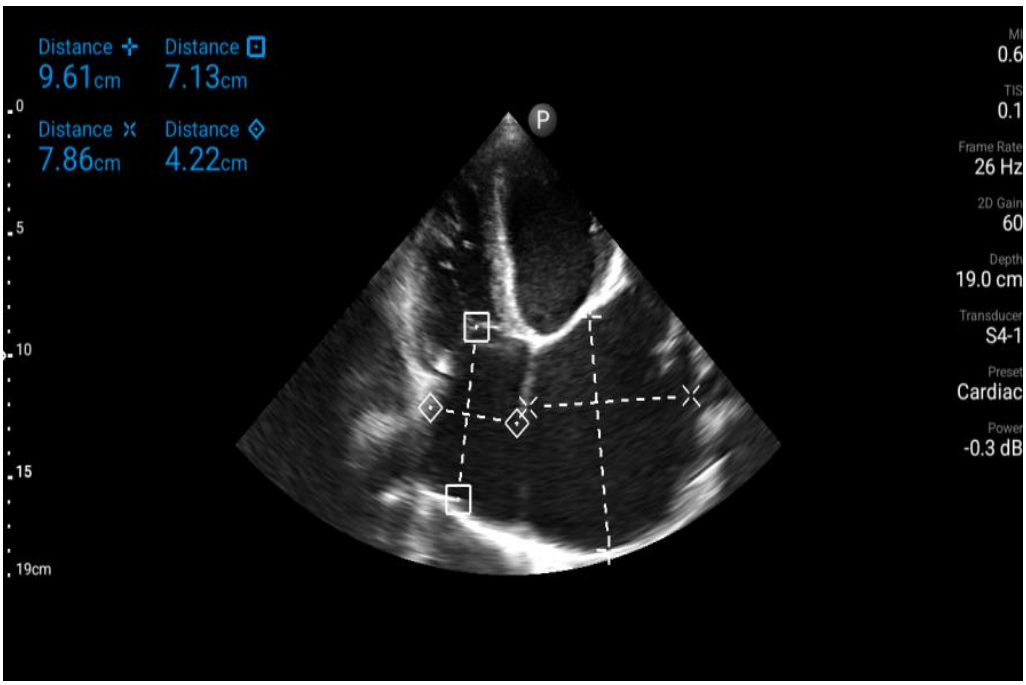

Figure 1. Apical four-chamber view with the left atria measuring 9.61cm x 7.86cm and the right atria measuring 7.13cm x 4.22cm.

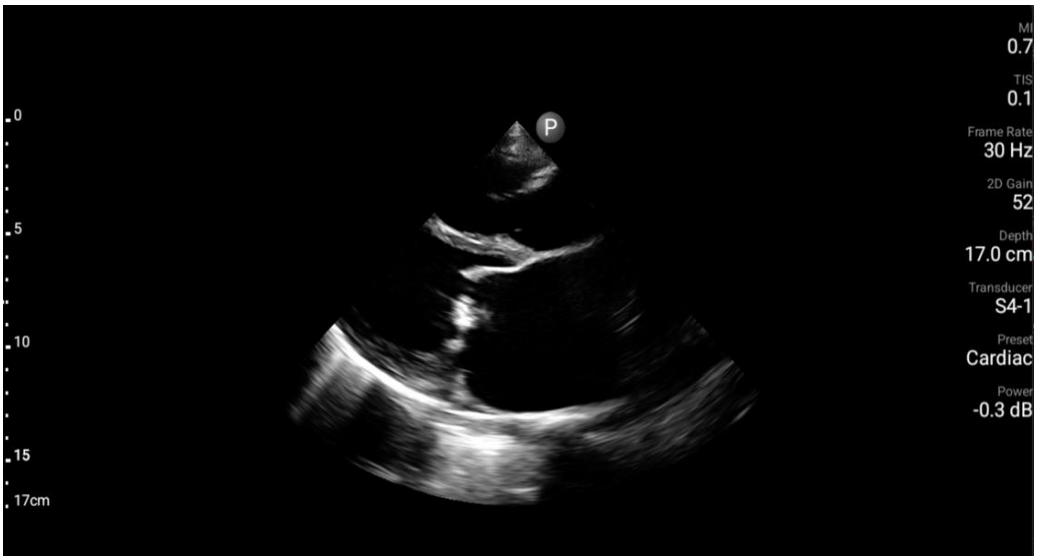

Figure 2. Subcostal view demonstrating mitral leaflet thickening (posterior >anterior) and hockey stick appearance of anterior mitral leaflet.

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Figure 3. Subcostal view showing left atrial dilation and mitral leaflet thickening.

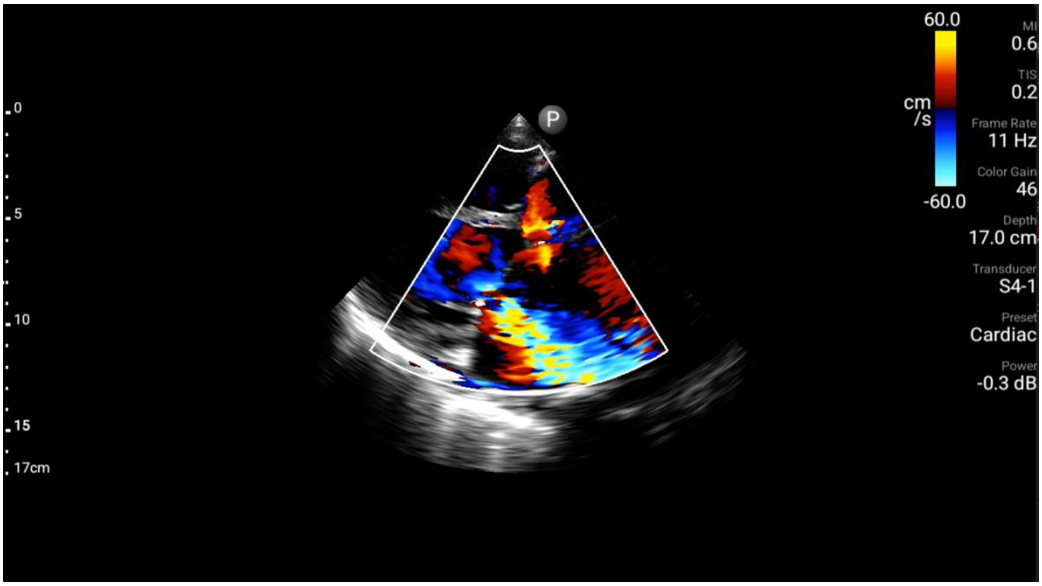

Figure 4. Parasternal long view with color doppler demonstrating moderate mitral regurgitation.

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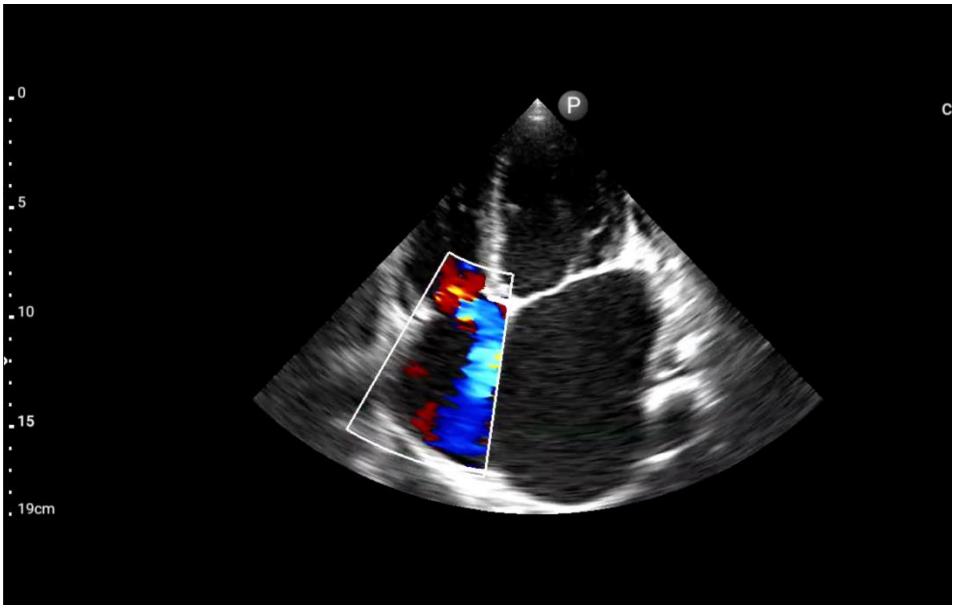

Figure 5. Apical four-chamber view with color Doppler showing severe tricuspid regurgitation

Due to the patient's unstable hemodynamics, synchronized electrical cardioversion was attempted after obtaining informed consent from the patient and her family. Ketamine 100 mg IV was administered for sedation, and unfractionated heparin 5000 IU IV was given for anticoagulation. The first attempt at cardio-version with 100 Joules (J) was unsuccessful. Subsequent attempts with escalating energy levels (150 J, 200 J x3) did not convert the patient's dysrhythmia. Despite five rounds of attempted cardioversion, the rhythm remained atrial fibrillation at a rate of 160-184bpm, with ongoing hypotension that was undetectable by the monitor.

Digoxin 0.25 mg IV was administered, but because of its longer half-life, it did not rapidly control heart rate or improve hemodynamics. Amiodarone 150 mg IV in 100ml of D5W over 10 minutes was then administered as a loading dose, successfully converting the rhythm to sinus and stabilizing the heart rate between 100 and 120 bpm. The patient also received 2 g of magnesium sulfate IV to address suspected electrolyte imbalances, as initial laboratory investigations were not immediately available.

Subsequent laboratory investigations revealed hyponatremia (128 mmol/L), hypokalemia (3.25 mmol/L), slightly elevated magnesium of 2.65 mg/dL (normal range: 1.7-2.10 mg/dL), and low ionized calcium of 1.06 mmol/L (normal range: 1.1-1.35 mmol/L). Hematological analysis demonstrated thrombocytopenia with a platelet count of 73,000/µL (reference range: 182,000–369,000/µL), a hemoglobin level of 11.4 g/dL (reference range: 11.2–15.7 g/dL), and a hematocrit of 32.7% (reference range: 34.1–44.9%). The white blood cell count was mildly elevated at 10,640/µL (reference range: 3.98–10.04/µL), with a neutrophil predominance of 62.4% and elevated liver enzymes (ALT 175 IU/L, AST 169 IU/L). The patient was transferred to the cardiac ICU for further management, with an amiodarone infusion initiated at 1mg/minute over six hours and 0.5 mg/minute over the next 18hours.

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3. Discussion

Approximately one-third of hospitalizations for cardiac rhythm abnormalities are due to atrial fibrillation, making it the most prevalent arrhythmia in clinical practice.[3] As the population ages and the prevalence of chronic heart disease rises, hospital admissions for atrial fibrillation are expected to increase further. [4]

The prevalence of atrial fibrillation in sub-Saharan African patients aged >40 and >70 was 4.3% and 0.7%, respectively. Risk factors for atrial fibrillation in the African population were valvular heart disease, hypertension, and cardiomyopathy. [5] A study in Bahirdar, Ethiopia, in 2023 looked at patients with rheumatic heart disease and found an even higher prevalence of atrial fibrillation at 43%, which is relevant to our case. [6]

Acute atrial fibrillation treatment objectives may include 1) AV nodal blocking agents to regulate ventricular rate, 2) anticoagulants to prevent thromboembolic events, and 3) first- and third-class antiarrhythmic medications to convert dysrhythmias to normal sinus rhythm (NSR). The preferred treatment of atrial fibrillation for hemodynamically unstable patients presented with syncope, hypotension, and chest pain is emergent electrical cardioversion. Therefore, pharmaceutical conversion techniques are only recommended for patients who are resistant to electrical cardioversion or who do not exhibit urgent symptoms. [7]

Atrial fibrillation is the most frequent electrically converted arrhythmia. In addition to patient-specific characteristics, transthoracic impedance, electrode positioning, and waveform type are the main determinants of electrical cardioversion success [2]. Initial success of electrical cardioversion may not be predicted by the patient's age. Long atrial fibrillation duration (>3 months), left atrium chamber size greater than 4.5, and prolonged alcohol use may be linked to a lower electrical cardioversion success rate, and serial electrical cardioversion may yield better results. According to multiple studies, the initial success rate of electrical cardioversion for atrial fibrillation ranges from 50% to 90%; however, only 50% of patients maintain sinus rhythm after a year. (8) The success rate of outpatient electrical cardioversion was found to be 88.6%, and the complication rate was low. However, atrial fibrillation recurred in 55.5% within 3 months. [9]

A common antiarrhythmic drug used in practice for both ventricular and atrial arrhythmias is amiodarone. It affects every stage of the cardiac action potential and is predominantly categorized as a class III antiarrhythmic.[10] The pharmacokinetics includes wide tissue distribution (40-84 L/kg), slow total body clearance (90-158 mL/h/kg), long terminal elimination half-life (20-47d), and extensive hepatic metabolism. Amiodarone is comparatively safe for patients with structural heart disease and patients with reduced left ventricular function. However, amiodarone is not superior to other antiarrhythmic medications typically used for pharmacological cardioversion of new-onset atrial fibrillation, such as flecainide and propafenone.[10] Despite being one of the safest antiarrhythmic drugs for patients with a low ejection fraction or clinical heart failure, amiodarone has notable negative inotropic effects that might cause hypotension in patients with depressed cardiac function. Individuals most at risk for this complication include patients who have had cardiac surgery, critically ill patients in shock, and patients with heart failure with an ejection fraction less than 35% ([11]. It can also cause moderate hypotension, bradycardia, phlebitis, and allergic reactions. [9]

There are a variety of other antiarrhythmic drugs that are frequently used in the treatment of atrial

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fibrillation. Flecainide and propafenone are both Class Ic sodium channel blockers that have slow association and dissociation of these channels in the myocardium. They are often administered to prevent paroxysmal atrial fibrillation episodes but are contraindicated in individuals with structural heart disease, such as our case patient, due to the risk of ventricular arrhythmia according to the Cardiac Arrhythmia Suppression Trials. [12]

Another antiarrhythmic that is frequently used for immediate pharmacologic cardioversion is procainamide, a Class Ia agent. While therapeutic levels are quickly achieved, it is known to cause hypotension with rapid administration and exacerbate heart failure symptoms in patients with pre-existing congestive heart failure. [13] Ibutilide, a Class III potassium channel blocker, has also demonstrated a significant conversion rate of up to 75-80% in patients with recent onset atrial fibrillation. [14] However, a notable adverse complication is monomorphic ventricular tachycardia, which is estimated to be as high as 4.9%. Therefore, the use of ibutilide requires at least 4 hours of post-infusion monitoring, which is suboptimal in a crowded, bed-blocked emergency department setting. Moreover, in a meta-analysis comparing the efficacy and safety profiles of amiodarone and ibutilide for the treatment of atrial fibrillation, the time to successful cardioversion was shorter in the amiodarone group, and the rate of cardiovascular adverse effects was higher in those treated with ibutilide. [15] Amiodarone appears to be the most effective and recommended drug in patients with frequent, recurrent, symptomatic atrial fibrillation, especially in the presence of structural heart disease. [16]

Maintaining normal sinus rhythm in patients with AF can be particularly challenging. In this case report, we present a patient with refractory atrial fibrillation likely secondary to advanced structural and valvular heart disease as possible predictive factors for unsuccessful electrical cardioversion. Here, we demonstrated that amiodarone was successfully used to chemically cardiovert the atrial fibrillation to sinus rhythm.

4. Conclusion

In this case, a 28-year-old female with chronic rheumatic valvular heart disease and severe mitral regurgitation presented with acute atrial fibrillation with rapid ventricular response. Initial management with digoxin and electrical cardioversion was unsuccessful, highlighting the challenges of achieving rate, rhythm control, and hemodynamic stability in patients with significant structural heart disease and persistent AF.

Amiodarone, administered as an intravenous bolus followed by infusion, successfully stabilized the heart rate and converted AF to sinus rhythm. This case underscores the importance of tailored management strategies in complex AF cases, especially in patients with underlying valvular pathology. The findings support the use of amiodarone as an effective option for pharmacologic cardioversion in similar clinical scenarios, while also emphasizing the need for careful monitoring of potential adverse effects.

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Competing interests

The authors declare no conflicts of interest.

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Case Report

Pan African Journal of Emergency and Critical Care (PAJEC)

Hyperkalemic Periodic Paralysis and Prompt Recovery in an Elderly Patient with Comorbidities: A Case from Addis Ababa, Ethiopia

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ABSTRACT

Hyperkalemic periodic paralysis (HPP) is a rare disorder typically of genetic origin, and its occurrence as a secondary condition in the elderly is exceptional. We report the case of an 80-year-old Ethiopian man with severe pulmonary hypertension and a suspected myeloproliferative disorder who presented with acute lower limb paralysis. Initial investigations revealed an extreme serum potassium level of 9.08 mmol/L with corresponding electrocardiographic changes, including widened QRS complexes and peaked T waves. Emergent treatment with intravenous calcium gluconate, insulin-dextrose, and fluids rapidly corrected the hyperkalemia, leading to the complete reversal of paralysis and cardiac abnormalities. This case is notable for the patient's advanced age and the severity of the hyperkalemia, highlighting the multi-factorial pathogenesis of secondary HPP where renal impairment, polypharmacy, and underlying hematologic disease may interact. It further demonstrates that prompt adherence to fundamental electrolyte management protocols is critical in preventing fatal outcomes in complex geriatric patients.

Keywords: Hyperkalemic periodic paralysis, Electrolyte imbalance, Muscle weakness, geriatric, secondary hyperkalemia, Ethiopia

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1. Introduction

Hyperkalemic periodic paralysis (HPP) is a rare neuromuscular disorder characterized by recurrent episodes of skeletal muscle weakness or paralysis, precipitated by elevated serum potassium levels. Classically linked to autosomal dominant mutations in the SCN4A gene, which encodes voltage-gated sodium channels in skeletal muscle, HPP disrupts membrane excitability, leading to transient depolarization and impaired muscle contraction. [(1)] While hereditary forms typically manifest in childhood or early adulthood, secondary or acquired hyperkalemic paralysis triggered by renal dysfunction, metabolic derangements, or pharmacological agents may present in older people, often complicating diagnosis and management.[(2)]

In geriatric populations, HPP poses unique challenges due to the convergence of age-related physiological decline, poly-pharmacy, and comorbidities, such as chronic kidney disease (CKD), cardiovascular disorders, and endocrine abnormalities. These factors amplify susceptibility to hyperkalemia and obscure the recognition of neuromuscular manifestations, delaying critical interventions.[(3)] Furthermore, life-threatening hyperkalemia (serum $K^+ > 7.0$ mmol/L) is rare in HPP, as most genetic variants induce milder potassium fluctuations. However, in individuals with superimposed acute kidney injury (AKI), the use of potassium-wasting diuretics, or myeloproliferative disorders, conditions that perturb potassium homeostasis, severe hyperkalemia may develop, escalating risks of fatal cardiac arrhythmias or respiratory muscle paralysis.

This case report details an 80-year-old male with acute flaccid paralysis and extreme hyperkalemia (9.08 mmol/L), a presentation exceptional in both magnitude and clinical complexity. The patient's comorbidities, including a suspected myeloproliferative disorder (MPD), severe pulmonary hypertension (PHTN), and AKI, highlight the multi-factorial etiology of hyperkalemia in HPP-like presentations. Specifically, diuretic therapy for PHTN, potential tumor lysis from MPD, and renal hypoperfusion likely synergized to precipitate this crisis. The case underscores the diagnostic pitfalls in distinguishing primary HPP from secondary paralysis in elderly patients, where overlapping pathologies demand a nuanced approach. Additionally, it demonstrates the critical role of rapid, protocol-driven management, even in resource-constrained settings, in reversing metabolic and neuromuscular threats.

This case is clinically significant for three reasons. First, it demonstrates that extreme, non-familial HPP can manifest in the geriatric population, expanding the typical demographic profile of the disease. Second, the severity of hyperkalemia (9.08 mmol/L) approaches the upper limits of survivable potassium levels, offering a rare window into the acute management of profound electrolyte-induced toxicity. Third, the patient's comorbidities, including a suspected myeloproliferative disorder, renal dysfunction, and poly-pharmacy, illustrate the multi-factorial nature of secondary HPP, where multiple acquired defects in potassium excretion and distribution converge. This report underscores the importance of prioritizing physiological principles over age-related diagnostic assumptions when managing acute paralysis with electrolyte derangement.

2. Method

Study Design: This is a single, descriptive case report.

Study Area and Setting: The patient was evaluated and managed at Care Land General Hospital, a private institution in Addis Ababa, Ethiopia, that serves a growing and significant number of communities in the region.

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Study Period: The patient presented to the emergency department on December 22, 2023, and was immediately admitted to the Intensive Care Unit (ICU), where all acute management and stabilization were performed.

Clinical Protocol and Materials: The patient was managed according to the hospital's emergency protocol for severe hyperkalemia with cardiac toxicity.

3. Case report

An 80-year-old male presented to the hospital with a three-day history of acute-onset bilateral lower extremity weakness, urinary incontinence, epigastric pain, and nausea. He reported easy fatigability and a burning sensation in his legs for the past year but denied recent trauma, potassium-rich dietary intake, vomiting, diarrhea, or cardio-respiratory symptoms. His medical history was significant for severe pulmonary hypertension (PHTN) with grade III left ventricular diastolic dysfunction and severe tricuspid regurgitation on recent echocardiography, as well as an ongoing investigation for suspected myeloproliferative disorder (MPD) pending bone marrow biopsy results. He also reported a fall from a horse three years prior without any sequelae. Chronic medications included spironolactone (25 mg daily), furosemide (40 mg daily), gabapentin (300 mg daily), and allopurinol (100 mg daily).

On admission, vital signs were stable (blood pressure: 131/60 mmHg; pulse: 50–60 bpm; respiratory rate: 20/min; SpO_2: 95% on room air). Physical examination revealed that the patient appeared acutely ill but was alert and oriented. Neurological assessment demonstrated bilateral lower extremity motor power of 2/5 and upper extremity power of 3/5, with preserved cranial nerve function and no focal deficits. Cardiovascular, respiratory, and abdominal examinations were unremarkable.

Initial laboratory investigations revealed life-threatening hyperkalemia (9.08 mmol/L), hyponatremia (129.4 mmol/L), acute kidney injury (creatinine: 1.45 mg/dL; urea: 154 mg/dL), moderate normocytic anemia (hemoglobin: 7.2 g/dL), leukocytosis (WBC: 46.57 × 10^3/µL with neutrophilia), and thrombocytosis (platelets: 563 × 10^3/µL). Electrocardiography showed widened QRS complexes and peaked T waves (Fig. 1), consistent with hyperkalemia-induced cardiotoxicity. Serial electrolytes demonstrated a gradual decline in potassium (from 9.08 to 5.76 mmol/L over four days) and resolution of AKI (creatinine: 0.83 mg/dL by day 5). During the hospitalization, hemoglobin levels fluctuated (range: 7.2–9.4 g/dL), and leukocytosis improved (WBC: 19.72 × 10^3/µL).

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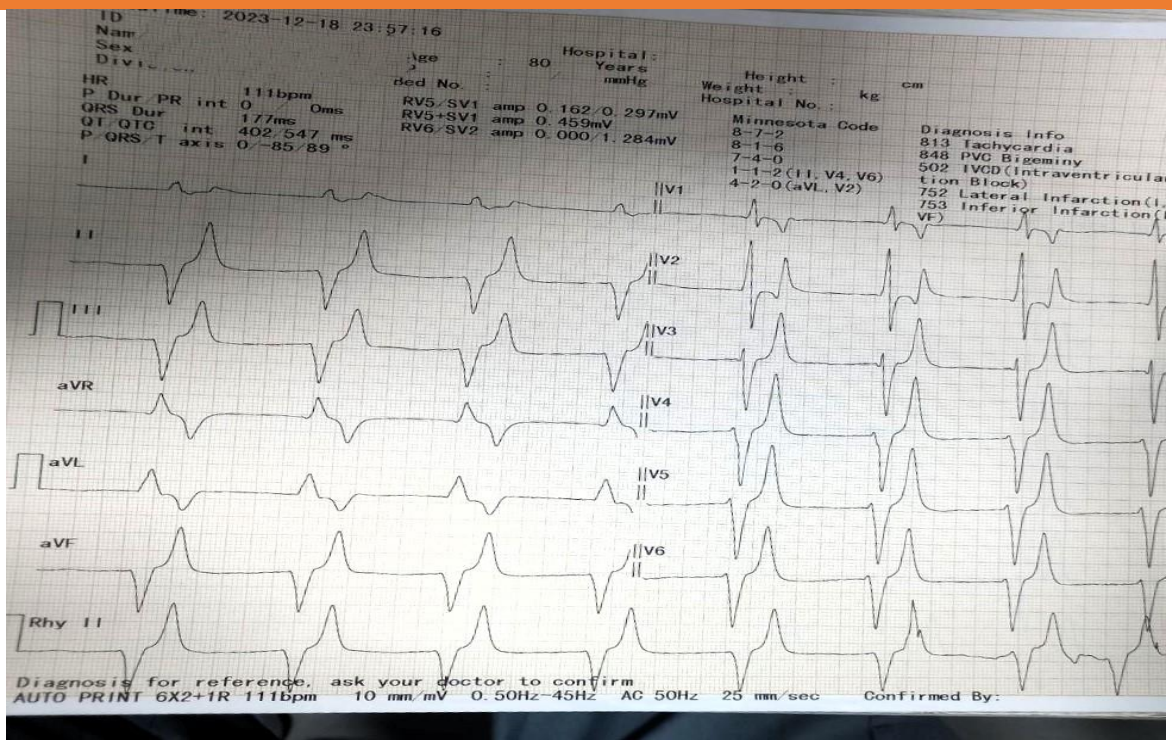

Fig 1: Initial ECG at admission showing wide QRS and peaked T waves, courtesy of Besufekad Taye. MD, ECCM Addis Ababa University

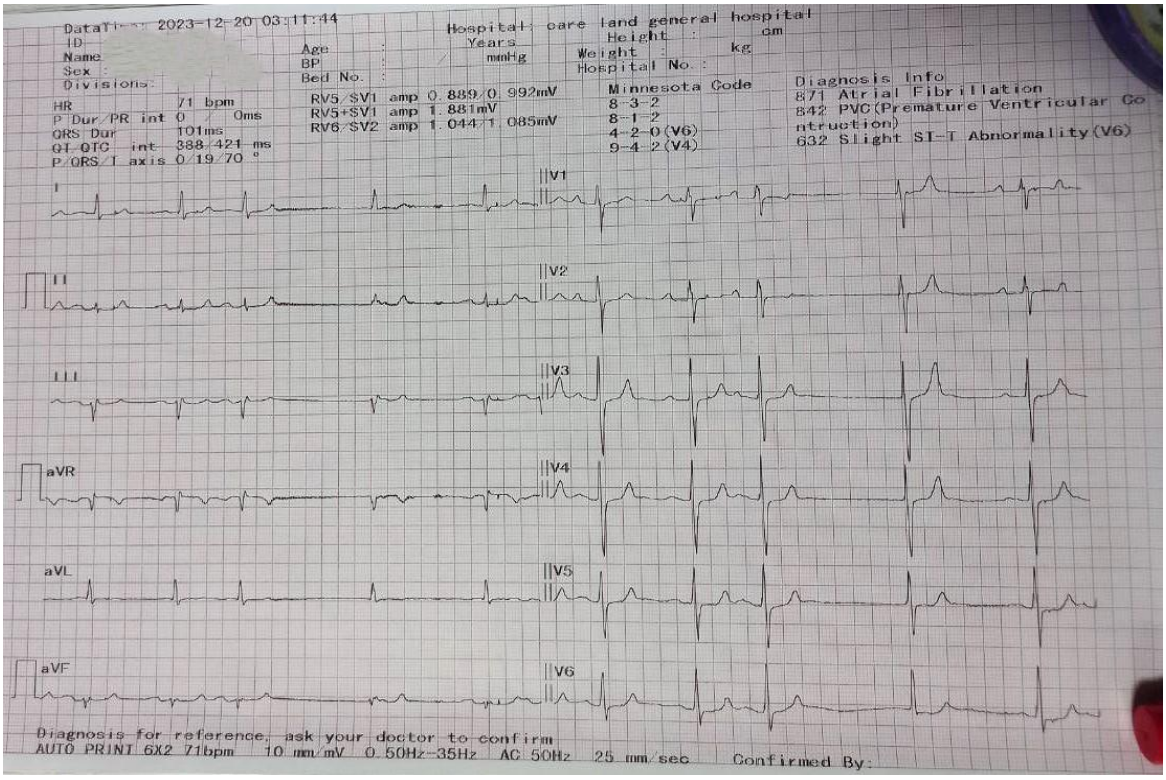

Fig 2: Last ECG of the patient after stabilization showing corrected QRS and T waves, courtesy of Besufekad Taye. MD, ECCM Addis Ababa University

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Treatment and outcome

The patient was admitted to the intensive care unit (ICU) with working diagnoses that included severe hyperkalemia (secondary to tumor lysis syndrome vs. MPD vs. acute-on-chronic kidney injury), hyperkalemic periodic paralysis, severe PHTN, and moderate anemia of undetermined etiology. He was managed emergently with intravenous calcium gluconate (2 g), insulin-dextrose (40 g dextrose + 10 IU regular insulin), nebulized salbutamol (10 puffs), and furosemide (60 mg IV bid). Normal saline and sodium bicarbonate were administered for volume expansion and correction of acidosis. A hematology consultation was sought for suspected tumor lysis syndrome (TLS) or MPD-related complications.

4. Discussion

This case of an 80-year-old male with acute hyperkalemic paralysis and life-threatening hyperkalemia (9.08 mmol/L) underscores the complex interplay of aging, comorbidities, and polypharmacy in precipitating electrolyte emergencies. While hyperkalemic periodic paralysis (HPP) is classically linked to SCN4A gene mutations causing skeletal muscle sodium channel dysfunction, secondary triggers renal impairment, myeloproliferative disorders (MPD), and potassium-altering medications, likely dominated in this geriatric patient. The rapid resolution of paralysis and hyperkalemia with standard therapies highlights the importance of distinguishing primary HPP from acquired hyperkalemic paralysis, particularly in older adults with multi-factorial risk factors.

Pathophysiology and Contributing Factors

The patient's severe hyperkalemia likely arose from a confluence of factors:

A. Renal Dysfunction: Acute kidney injury (creatinine: 1.45 mg/dL) impaired potassium excretion, exacerbated by diuretic therapy (spironolactone and furosemide). [(2)] Spironolactone, a potassium-sparing agent, poses a significant risk of hyperkalemia in patients with renal insufficiency, particularly in the elderly with reduced glomerular filtration rates. [(2)]

B. Myeloproliferative Disorder (MPD): The suspected MPD raises the possibility of tumor lysis syndrome (TLS), though the absence of elevated uric acid or phosphate makes this less likely. Alternatively, marked leukocytosis (WBC: 46.57 × 10^3/μL) may reflect cellular potassium release or cytokine-driven membrane instability.

C. Pulmonary Hypertension (PHTN) Management: Diuretic therapy for PHTN likely contributed to volume depletion, worsening renal perfusion, and promoting potassium retention.

D. Aging Physiology: Age-related declines in renal function, muscle mass, and β-adrenergic responsiveness impair potassium regulation and exacerbate neuromuscular susceptibility to hyperkalemia.

Clinical and Therapeutic Considerations

The patient's presentation, flaccid paralysis, peaked T waves, and widened QRS complexes, aligns with hyperkalemia-induced depolarization block in skeletal and cardiac muscle. The absence of a family history or childhood-onset symptoms argues against hereditary HPP, favoring secondary paralysis from acute-on-chronic hyperkalemia. Prompt intervention with calcium gluconate (membrane stabilization), insulin-dextrose (intracellular potassium shift), salbutamol (β-agonist-mediated cellular uptake), and furosemide (enhanced excretion) successfully averted fatal arrhythmias or respiratory compromise. Nota-

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bly, despite severe initial hyperkalemia, renal recovery (creatinine: 0.83 mg/dL by day 5) and potassium normalization were achieved without dialysis, underscoring the efficacy of conservative management in resource-constrained settings. [4]

Differential Diagnoses and Diagnostic Challenges

Alternative causes of acute paralysis, such as Guillain-Barré syndrome or spinal cord pathology, were excluded by the temporal association with hyperkalemia, the absence of sensory deficits, and the rapid response to electrolyte correction. Similarly, rhabdomyolysis and adrenal insufficiency were deemed unlikely given normal creatine kinase levels and the clinical context. [2] This case emphasizes the need to prioritize reversible metabolic etiologies in elderly patients presenting with acute weakness, particularly those on nephrotoxic or potassium-affecting medications.

Implications for Geriatric Care

This case illustrates critical lessons for managing hyperkalemia in older adults:

Poly-pharmacy Vigilance: Potassium-sparing diuretics require rigorous monitoring in patients with renal impairment or hematologic disorders.

Multidisciplinary Approach: Collaboration among nephrology, hematology, and critical care teams is essential to address overlapping contributors (e.g., MPD, AKI, and diuretic effects).

Resourcefulness in Resource-Limited Settings: Basic interventions, calcium, insulin, and β-agonists, remain cornerstone therapies even when advanced options like dialysis are unavailable.

Limitations and Unanswered Questions

This case has several limitations. The pending bone marrow biopsy leaves the role of MPD-associated mechanisms speculative. Additionally, genetic testing for SCN4A mutations was unavailable, although the clinical picture strongly favored secondary triggers. Long-term management will hinge on optimizing diuretic regimens, definitively addressing the suspected MPD, and preventing recurrent AKI.

5. Conclusion

This case reinforces hyperkalemia as a reversible yet life-threatening cause of paralysis in elderly patients. It highlights the need for heightened suspicion of multi-factorial hyperkalemia in aging populations, particularly those with renal dysfunction, hematologic disorders, or high-risk medications. Timely, protocol-driven intervention can mitigate catastrophic outcomes, even in complex clinical scenarios.

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Competing interests

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Pan African Journal of Emergency and Critical Care (PAJEC)

Corridor Care in Emergency Departments: A Still Existing Symptom of Systemic Strain in Ethiopian Public Hospitals

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While often employed to maintain patient flow, the increasingly observed practice of corridor care in emergency departments (EDs) across Ethiopia raises serious concerns about patient safety, privacy, dignity, and the overall quality of care.

EDs worldwide are increasingly challenged by overcrowding, a condition where patient demand exceeds the capacity to provide timely and appropriate care.[1] In low- and middle-income countries (LMICs), this issue is compounded by limited infrastructure, staffing shortages, and high patient volumes.[2] One visible manifestation of overcrowding is corridor care, the practice of treating patients in hallways or non-designated clinical spaces due to a lack of available beds.[3]

Recent findings from tertiary referral centers in Ethiopia revealed critically high National Emergency Department Overcrowding Scale (NEDOCS) scores, with a median of 476.5, far exceeding thresholds for safe care, below 100 scores.[4, 5]

At St. Paul`s Hospital Millennium Medical College (SPHMMC), severe bed shortages, responsible for 77.9% of delays, have led to routine corridor care, with nearly 60% of patients staying in the 15-bed ED for over 24 hours and some up to 16 days, despite managing 25–30 daily visits and over 22,000 cases in 30 months.[4, 6]

Corridor care in Ethiopia is common yet under-researched, with insufficient documentation potentially normalizing practices that jeopardize patient outcomes and ethical standards for providers. Healthcare workers face moral injury and burnout when forced to deliver care in environments that violate professional standards.[4, 7]

This issue is especially pronounced in teaching hospitals, where practitioners, often early-career professionals, are exposed to high patient volumes, limited resources, and ethically challenging environments. These conditions contribute to emotional exhaustion, reduced clinical performance, and long-term attrition among the workforce.

Corridor care in EDs, particularly in overcrowded systems like SPHMMC, has significant clinical and workforce consequences. Patients treated in corridors often experience delays in diagnostics, medication administration, and monitoring due to limited access to equipment and staff.

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Overcrowded EDs and corridor care are linked to higher rates of adverse events and early mortality, especially among high-acuity patients. [11] Non-clinical spaces lack proper sanitation and isolation protocols, increasing the risk of hospital-acquired infections. Healthcare providers report burnout and moral injury, and chronic exposure to conditions of corridor care contributes to higher staff turnover, especially among early-career professionals in teaching hospitals. [7]

The Royal College of Nursing calls corridor care "unsafe, undignified, and unacceptable" and urges its elimination. (9) Health Foundation experts warn that it "risks normalizing substandard care delivery" and undermines both patient safety and staff morale. [10, 11]

Researchers emphasize that corridor care should not be abolished without viable alternatives, but must be addressed through systemic reform. [11]

Systemic and policy implications of corridor care encompass normalizing substandard care, increased ambulance offload times, and a decline in public trust as patients lose confidence in the health system. This letter calls for recognizing corridor care as a systemic failure, advocating for infrastructure investment to enhance ED bed capacity and inpatient flow, mobilizing academic institutions to conduct research, and supporting the workforce to prevent burnout and ensure ethical safeguards for frontline providers.

I urge the Pan African Journal of Emergency and Critical Care (PAJEC/ESEP) to spearhead research into corridor care, highlighting its effects on patients and providers. PAJEC's role as a regional platform in emergency medicine positions it to stimulate dialogue, guide policy, and advocate for evidence-based solutions to the ongoing issues in Ethiopian hospitals.

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