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EDITORIAL

Ethiopian Emergency Medical Services: Bridging up the Gaps in Pre-hospital Services

ORIGINAL ARTICLE

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CASE REPORT

Spontaneous termination of unstable ventricular tachycardia in emergency department: A case report

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Nursing Science Trend, Current and Challenges in Ethiopia: A Narrative Review Evidence from Recent Literature and Policies

Ethiopian Society of Emergency and Critical Care
Professionals



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Ethiopian Emergency Medical Services: Bridging up the Gaps in Pre-hospital Services

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Emergency medical services (EMS) delivered to patients requiring resuscitation, stabilization, or preventive care prior to their transfer to a healthcare facility are known as pre-hospital care ⁽¹⁾. In Ethiopia, insufficient pre-hospital emergency services significantly impact the healthcare system, contributing to the country's elevated rates of morbidity and mortality from preventable conditions. Communities with limited access to healthcare facilities are particularly impacted by the absence of a structured pre-hospital care system. This delay in receiving essential pre-hospital services exacerbates health disparities and contributes to unfavorable health outcomes ^(2, 3).

Ethiopia's public health has been severely affected by the lack of pre-hospital care. The undesirable outcomes of acute illness and injuries, such as death, impairments, and high healthcare costs, are caused by both the severity of the initial illness or injury and the delay in receiving pre-hospital care ⁽²⁾. Particularly vulnerable groups, such as women, children, and older people, suffer disproportionately as a result of extra variables impeding their prompt access. Enhancements in this field are critically needed since they could lead to a considerable reduction in the mortality and disability associated with trauma and other acute medical conditions ^(1, 3).

A comprehensive pre-hospital care framework must be established to enhance health outcomes in the Ethiopian health care system. In order to do this, funds must be allocated for emergency medical technician training, a pre-hospital care system must be established, and national EMS guidelines and protocols must be developed to standardize care ^(2, 3). Creating a dependable emergency communication system and raising community knowledge of available services can also help to speed up response times ⁽²⁾. Building sustainable pre-hospital care systems requires improving logistical and other necessary resources, which can be achieved through cooperation and collaborative effects with relevant stakeholders, including governmental, non-governmental, and international organizations ⁽²⁻⁵⁾.

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Key words: pre-hospital care, emergency medical services, pre-facility medical care, Ethiopia

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Therefore, quick action is needed to overcome Ethiopia's pre-hospital shortcomings, underscoring the significance of an integrated and closely watched strategy. Ethiopia's health results and economic growth could suffer significantly if these gaps are not addressed.

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Nosocomial Infection Rates and Preventive Strategies in the Intensive Care Unit at Rwanda Military Hospital: A Retrospective Analysis

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ABSTRACT

Background: Nosocomial infections, occurring >48 hours after admission without evidence of pre-existing incubation, pose a significant challenge in intensive care units (ICUs), particularly for patients with prolonged hospital stays. In the 21st century, these infections affect approximately 10% of hospitalized patients, with higher rates observed in ICU settings. They contribute to extended hospitalization, disability, and economic burden. This study aims to evaluate the effectiveness of preventive measures in controlling nosocomial infections at Rwanda Military Hospital's ICU.

Materials and Methods: A retrospective cross-sectional study was performed on patients admitted to the ICU at Rwanda Military Hospital between January 2019 and December 2020. Data on nosocomial infections were retrieved from OpenClinic HMIS software, ICU registries, and patient files. Statistical analysis was performed using Microsoft Excel 21 and SPSS 21.

Results: Among 531 ICU admissions during the study period, 18% were identified with nosocomial infections. The infection rate was slightly higher in males (20%) compared to females (16.5%), with Enterobacteriaceae bacteria being the most common pathogens identified (35%).

Conclusions: Nosocomial infections remain prevalent in our ICU setting, highlighting the importance of adherence to infection prevention guidelines. Poor implementation of these guidelines emerges as a significant risk factor for nosocomial infections.

Keywords: Nosocomial infection, Hospital-acquired infections, healthcare-associated infections, infection control, hand hygiene, multidrug resistance, antibiotic resistance, preventive guidelines

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1. Introduction

Despite the significant advancements in medical care, nosocomial infections (NIs) remain a critical challenge, particularly in Intensive Care Units (ICUs) where vulnerable patients are most at risk⁽¹⁻⁴⁾. While global studies have highlighted the prevalence and impact of NIs^(5,6), there is a noticeable gap in research specific to Rwanda, especially regarding the implementation of prevention and control measures in ICU settings. This gap underscores the need for focused research on the effectiveness of current infection control strategies in Rwanda's ICUs, specifically at Rwanda Military Hospital (RMH)-Kanombe.

Previous studies in Rwanda have reported varying rates of nosocomial infections across different departments and patient demographics⁽⁸⁻¹⁰⁾. However, these studies often lacked a comprehensive analysis of ICU-specific data, where the risk of NIs is significantly higher⁽⁷⁾. Moreover, the effectiveness of implemented prevention measures remains underexplored, with limited evidence on how well these guidelines are adhered to in practice. The challenge lies in understanding these measures' actual implementation and effectiveness in real-world settings, which past research has not adequately addressed⁽¹¹⁻¹³⁾.

The current study aims to fill this gap by assessing the prevalence of nosocomial infections in the ICU at Rwanda Military Hospital-Kanombe and evaluating the implementation of preventive measures. This study is crucial as it not only provides ICU-specific data but also offers insights into the effectiveness of current infection control strategies. By identifying gaps in implementing these measures, the study aims to contribute to developing more effective strategies tailored to the ICU environment. This research is particularly

important as it addresses the urgent need to improve patient outcomes in critical care settings by reducing the incidence of nosocomial infections.

The primary objective of this study is to assess the prevalence of nosocomial infections in the ICU at Rwanda Military Hospital-Kanombe and to evaluate the adherence to and effectiveness of infection prevention and control measures. The study seeks to identify specific gaps in the implementation of these measures, providing actionable insights for enhancing patient safety and reducing the burden of nosocomial infections in ICUs.

2. Methods

Study design

To assess the implementation measures for preventing and controlling HAIs and identify gaps within these measures in the ICU at RMH, we used a retrospective study of all patients who were diagnosed with nosocomial infection due to their hospitalization in ICU department at RMH from 1st Jan 2019-31st Dec 2020.

Study Setting

The study was conducted in RMH in Nyarugunga Sector, Kicukiro District, and Kigali City. RMH is one of the four referral hospitals in Rwanda that serves the military and civilian population. It has different outpatient and inpatient departments, laboratory, medical and surgical departments, diagnostic imaging department and other support services. ICU is one of inpatient services and it can accommodate 12 beds.

Study Population

Our study included 531 patients admitted to ICU at RMH from January 2019- December 2020.

Inclusion and Exclusion Criteria

Inclusion criteria

All patients who were diagnosed with nosocomial infection due to their admission in ICU at RMH from 1st Jan 2019-31st Dec 2020 were included in this study.

Exclusion criteria

- Patients who already had an infection at the time of admission to the ICU.
- Patients who were admitted to the ICU with severe immunosuppression
- Patients who were admitted to ICU for less than 48 hours
- Patients who were transferred from other hospitals during the study time.

Data Collection

Data was collected through a questionnaire, utilizing the OpenClinic HMIS, ICU daybook, and patients' files. A Google Form questionnaire was distributed to assess ICU nurses' practices, with participation open during day working hours. Seven nurses, representing approximately one-third of the total nursing staff, responded to the questionnaire. The data collection occurred during daytime shifts, as the data collector was on duty during these hours.

Data Analysis

Data recorded and questionnaire were entered in a computer. The Statistical Package for Social Studies (SPSS version 21) was used to analyze data. Descriptive and inferential statistics 28 was used in the analysis of data. The margin of error was set at 0.05; thus, a p-value of less than 0.05 was considered significant.

Data Management

After data collection, questionnaires and checklists were stored in a locked cupboard with the key kept by the research team's leader. A strong password was used to secure the computer within which data had been collected. All soft and

hard documents were kept confidential and used for the purpose of research only. These research documents will be kept confidential for five years and destroyed by shredding and incineration, while the soft copies will remain permanently stored in the e-archive.

Ethical consideration

- Participants were explained the purpose of this research and were handed a google-form document explaining in details the purpose of this research.
- Informed consent: After a thorough explanation of our research to the participants (ICU healthcare workers), they had right to sign the informed consent before participating in our research. No patient consent was required since the study was not directly involving patients.
- Confidentiality to protect the participants: No personal identification of the participants appeared into our questionnaire, only the initials were used instead. Also, to ensure the confidentiality of our participants, only initials were used on the checklist instead of personal identification. We kept the information on data collection sheet with the highest privacy and the information gathered was used for research purpose only.

3. Result

The cohort of patients admitted to the ICU at RMH-Kanombe between Jan-2019 and Dec-2020 consisted of 531 patients. Among these patients, 53.3% were males.

Most ICU admissions were middle-aged patients (54.2%, aged 30-60 years). Young patients accounted for 34.3%, while elderly patients made up 11.5% of the admissions. It was found that 18% had nosocomial infections, also known as

health-acquired infections. Patients across different age groups demonstrated similar probabilities (approximately 16%) of acquiring these infections (Table 1).

Gram data were collected from 98 patients who underwent culture. Of these, 54% were found to have gram-positive bacteria, while 46% had gram-negative bacteria.

Enterobacteriaceae was the most common pathogen, responsible for infections in 34.69% of the affected patients. This was followed by Coagulase-Negative Staphylococcus, which accounted for 15.31% of cases. Less prevalent infections, each contributing 1.02% to the total, including Aerobic and Anaerobic Cocci, Staphylococcus saprophyticus, Streptococcus viridans, Staphylococcus coagulase, and Klebsiella species (Table 2).

Ciprofloxacin was the primary treatment for the majority of patients (18%), followed by Imipenem (13%) and Vancomycin (10%) (Table 3). Out of the 30 sampled nurses, a significant majority (97%) demonstrated awareness of all necessary measures to prevent nosocomial infections. Addi-

tionally, an equal percentage of nurses (97%) confirmed their adherence to these established protocols.

The patient load assigned to a nurse during any given shift can constitute a potential risk factor for nosocomial infections. Nurses were surveyed regarding their perspectives on the manageable number of patients they could attend to individually during both day and night shifts. Findings (Figure 5) revealed that irrespective of the shift, there was only a 10% likelihood of a nurse caring for a single patient. On day shifts, there was a higher probability (67%) of a nurse attending to two patients. Additionally, there was a 23% chance of a nurse tending to three or more patients. Conversely, during night shifts, the patient load per nurse tended to increase. The data illustrated that 53% of nurses were responsible for caring for three or more patients (43% for a 1:3 ratio and 10% for a >1:3 ratio) during night shifts. This represents a 30% increase compared to day shifts (from 23% to 53%). Furthermore, the likelihood of a nurse caring for two patients during a night shift stood at 37%.

Table 1. Association between patients' characteristics and nosocomial infections in the ICU at Rwanda Military Hospital from January 2019 to December 2020. Study population: 531 patients

Characteristics	Yes	No	Total	Chi-Square	P-value
Gender	N (Percent)	N (Percent)		1.144	0.285
Male	57 (20.1%)	226(79.9%)	283		
Female	41(16.5%)	207(83.5%)	248		
Total	98(18.5%)	433(81.5%)	531		
Age	N (Percent)	N (Percent)		1.185	0.553
18-39 years	30(16.5%)	152(83.5%)	182		
40-59 years	58(20.1%)	230(79.9%)	288		
60 years and above	10(16.4%)	51(83.6%)	61		
Total	98(18.5%)	433(81.5%)	531		

Overall, the chi-square values are not statistically significant since their corresponding p-values are greater than the level of significance of 5%. For gender, the p-value is 0.285 whereas that of age

is 0.553; all >0.05. Therefore, patients' characteristics had no significant effect of development of nosocomial infections.

Table 2. Types of Microorganisms Observed in the ICU at Rwanda Military Hospital from January 2019 to December 2020. Study population: 531 patients

Bacteria	Frequency	Percentage
Aerobes and anaerobes cocci	1	1.02
Bacilli	3	3.06
Coagulase negative	2	2.04
Coagulase negative cocci	2	2.04
Coagulase-negative staphylococcus	15	15.31
Cocci	5	5.10
Enterobacteriaceae	34	34.69
Grayish Colonies Cocci	1	1.02
Klebsiella species	1	1.02
Pseudomonas aeruginosa bacilli	3	3.06
Rods	6	6.12
Staphylococcus	2	2.04
Staphylococcus coagulase negative	3	3.06
Staphylococcus coccus	1	1.02
Staphylococcus aureus	14	14.29
Staphylococcus coagulase/Enterobacteriaceae	1	1.02
Staphylococcus saprophyticus	1	1.02
Staphylococcus coagulase	2	2.04
Streptococcus viridans	1	1.02

Table 3. Frequency of antibiotics prescribed to patients with NIs in the ICU at Rwanda Military Hospital from January 2019 to December 2020. Study population: 531 patients

Antibiogram	Frequency	Percent
Amikacin	4	4.9
Cefotaxime	4	4.9
Ceftazidime	1	1.2
Ceftriaxone	1	1.2
Ciprofloxacin	15	18.3
Clindamycin	7	8.5
Erythromycin	6	7.3
Gentamycin	7	8.5
Imipenem	11	13.4
Levofloxacin	3	3.7
Meropenem	5	6.1
Nitrofurantoin	3	3.7
Penicillin	1	1.2
Piperacillin	2	2.4
Tazobactam	1	1.2
Tetracycline	3	3.7
Vancomycin	8	9.8
Total	82	100.0

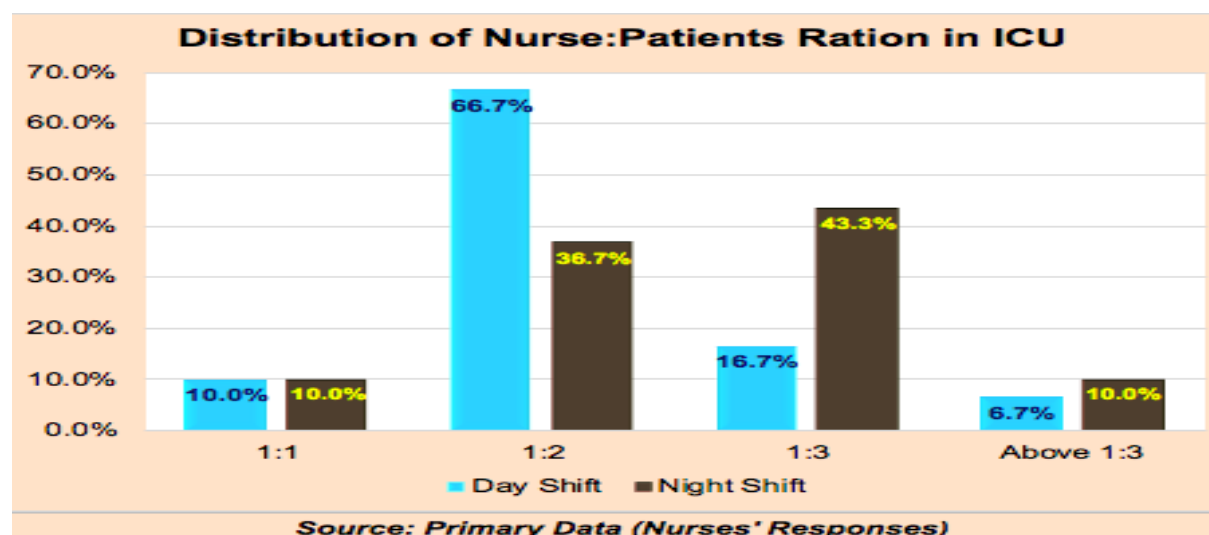


Fig 1. Nurse to Patients Ratio in the ICU at Rwanda Military Hospital from January 2019 to December 2020. Study population: 531 patients

Table 4. Implementation of NIs Prevention Measures in the ICU at Rwanda Military Hospital from January 2019 to December 2020. Study population: 531 patients

Measures	Yes	No	Total
	N(Percent)	N(Percent)	
Vaccinated for Covid-19 and Hepatitis B	30(100.0%)	0(0.0%)	30
Always wear protective wares in ICU like Gloves, surgical mask, protective eye shield, gown before touching a Patient	20(66.7%)	10(33.3%)	30
Always antiseptic wash hands before and after encountering each patient.	18(60.0%)	12(40.0%)	30
Presence of clear disposal system of waste materials in ICU	26(86.7%)	4(13.3%)	30
Always dispose waste materials where they should be	25(83.3%)	5(16.7%)	30
Always disinfect medical materials after its use	24(80.0%)	6(20.0%)	30
Presence of effective methods to sterilize and protect medical equipment in ICU	21(70.0%)	9(30.0%)	30
Timely and easy accessibility of materials to wash hands and disinfect hands to others.	27(90.0%)	3(10.0%)	30
Always do invasive catheterization in a sterile way	26(86.7%)	4(13.3%)	30
Routinely replace catheters within 48 hours if it was placed without aseptic technique.	8(26.7%)	22(73.3%)	30
Promptly remove a catheter that is no longer needed	20(66.7%)	10(33.3%)	30
Minimize sedation and length for intubation to minimize pooled secretions and elevate the bed 30 to 45 degrees	22(73.3%)	8(26.7%)	30
Always do oral care with either saline or antiseptic	8(26.7%)	22(73.3%)	30
Always give GI Ulcer prophylaxis to every patient to decrease ventilator associated pneumonia	21(70.0%)	9(30.0%)	30
Always have antiseptic to clean insertion site	15(50.0%)	15(50.0%)	30

Always avoid femoral veins when possible during central line insertion	22(73.3%)	8(26.7%)	30
Presence of efficient strategies to avoid to cross-contamination among patients	24(80.0%)	6(20.0%)	30
Always have appropriate diagnostic testing method when clinically indicated like: bottles for blood culture, materials for swabs, ...	22(73.3%)	8(26.7%)	30
Easy access of ICU patients to paramedical investigations like Chest X-rays, Ultrasounds, CT scan	24(80.0%)	6(20.0%)	30
Provision of prevention guidelines to patients in ICU	26(86.7%)	4(13.3%)	30
Change gown every time you finish patient care	12(40.0%)	18(60.0%)	30

Least Respected Measures:

Oral Care: Only 27% of respondents always do oral care with Chlorhexidine.

Catheter Replacement: 27% routinely replace catheters within 48 hours if placed without aseptic technique.

Protective Wares (Third Party): 40% ensure that every third party (caretakers, other department's healthcare providers) wears protective wares before entering the ICU.

Chlorhexidine for Insertion Site: 50% always have Chlorhexidine to clean the insertion site.

Moderately Respected Measures:

Protective Wares (ICU): 67% always wear protective wares like gloves, surgical masks, protective eye shields, and gowns before touching a patient in the ICU.

Hand Hygiene: 60% always wash hands before and after encountering each patient.

Catheter Removal: 67% promptly remove a catheter that is no longer needed.

Highly Respected Measures:

Vaccination: 100% of respondents are vaccinated for COVID-19 and Hepatitis B.

Waste Disposal System: 87% confirm the presence of a clear disposal system of waste materials in the ICU.

Disinfecting Medical Materials: 80% always disinfect medical materials after use.

Sterilization Methods: 70% acknowledge the presence of effective methods to sterilize and protect medical equipment in the ICU.

Hand Hygiene Accessibility: 90% report timely and easy accessibility of materials to wash and disinfect hands.

Catheterization Technique: 87% always perform catheterization in a sterile way.

Sedation and Intubation: 73% minimize sedation and intubation length to reduce pooled secretions and elevate the bed to 30 to 45 degrees.

Stress Prophylaxis: 70% always give stress prophylaxis to decrease ventilator-associated pneumonia.

Cross-Contamination Prevention: 80% report the presence of efficient strategies to avoid cross-contamination among patients.

Diagnostic Testing Accessibility: 73% confirm the availability of appropriate diagnostic testing methods when clinically indicated.

Paramedical Investigation Access: 80% report easy access for ICU patients to paramedical investigations like chest X-rays, ultrasounds, and CT scans.

Prevention Guidelines: 87% report that prevention guidelines are provided to patients in the ICU.

4. Discussion

This study revealed that 18% of patients admitted to the ICU at Rwanda Military Hospital (RMH) encountered at least one nosocomial infection, a figure that underscores the ongoing challenge of infection control in critical care environments. Notably, the study found no statistically significant association between demographic characteristics, such as age and gender, and the likelihood of developing a nosocomial infection. This finding contrasts with other research conducted in different settings in Rwanda where for instance one study highlighted that male patients had a significantly higher prevalence of nosocomial infections, indicating that gender might play a role in certain contexts⁽¹⁷⁾.

The discrepancy in findings could be attributed to study design and population variations. Our study focused specifically on ICU patients, a cohort that is generally more vulnerable due to severe illness and invasive procedures, while other studies included a broader range of hospital patients. For example, a 2019 study in Rwanda at Centre Hospitalier Universitaire de Butare (CHUB) in the pediatric department, found a nosocomial infection prevalence of 12.1% among infants⁽⁹⁾, a rate lower than that observed in our ICU-specific study. Similarly, a 2020 cohort study of 191 patients at a tertiary referral hospital in Rwanda reported a 32% prevalence of nosocomial infections across the entire hospital⁽¹⁸⁾, which is notably higher than the 18% found in our ICU

population. This disparity highlights how different patient populations and hospital departments can influence infection rates.

The variability in nosocomial infection rates across studies emphasizes the need for tailored infection prevention strategies. For instance, studies have shown that certain departments, like surgery, may have unique risk factors contributing to nosocomial infections. A study conducted in 2021 in two district hospitals in Rwanda reported an 11.7% prevalence of nosocomial infections⁽¹⁷⁾, focusing mainly on patients in the surgical department. These findings, when compared to our study, suggest that specific hospital areas, such as ICUs, may require more rigorous and specialized infection control measures.

In addition to prevalence rates, the types of microorganisms associated with nosocomial infections also vary by region and hospital. Our study identified Enterobacteriaceae as the most prevalent microorganism in the ICU, accounting for 34.7% of infections. This contrasts with findings from a study at Kenyatta National Hospital in Kenya, where *Pseudomonas aeruginosa*, *Klebsiella*, *Citrobacter*, and *Staphylococcus* species were among the most frequently isolated pathogens. Particularly concerning is the high prevalence of Methicillin-Resistant *Staphylococcus Aureus* (MRSA) reported in 31.5% of cases in Mulago Hospital in Uganda⁽¹⁹⁾. This highlights the regional variations in pathogen prevalence and the importance of localized infection control protocols.

Despite the implementation of various infection prevention measures, our study found significant gaps in adherence to best practices. For instance, regular oral care with Chlorhexidine and the timely replacement of catheters placed without aseptic technique were poorly implemented,

with only 27% adherence for each. Similarly, only 40% of respondents reported consistent use of protective wear by third parties entering the ICU. These lapses in protocol adherence suggest that while guidelines exist, their enforcement and routine practice may be lacking, thereby increasing the risk of nosocomial infections.

The literature underscores the importance of rigorous hygiene practices in reducing nosocomial infections. However, our findings reveal that even well-established measures are not universally respected. No single measure in our study achieved 100% compliance, indicating a significant need for improvement in hospital hygiene practices. Advocacy and training for healthcare workers, patients, and caregivers are crucial to enhancing adherence to infection prevention guidelines and ultimately reducing the prevalence of nosocomial infections.

The study underscores the complexity of nosocomial infection control, particularly in critical care settings like the ICU. While demographic factors may not significantly influence infection rates, the type of care setting, regional pathogen profiles, and adherence to hygiene protocols play a crucial role. Moving forward, hospitals must prioritize the consistent application of infection prevention measures across all departments to safeguard patient health and improve treatment outcomes.

5. Conclusion

The current study found that 18% of patients in the ICU at one institution experienced nosocomial infections. While demographic factors such as gender and age did not significantly influence the likelihood of infection, the study highlighted gaps in the implementation of preventive guidelines. The incomplete adherence to these guidelines could contribute to the continued presence

and potentially rising rates of nosocomial infections. The study was conducted in a single institution, which may limit the generalizability of the findings to other settings. The study focused exclusively on ICU patients, potentially overlooking factors specific to other hospital departments that may influence nosocomial infection rates. The reliance on self-reported adherence to guidelines may have introduced bias, as actual practices could differ from what was reported. The study, on the other side, provides valuable insights into the prevalence of nosocomial infections in an ICU setting, where patients are at higher risk due to the nature of their conditions and treatments. It contributes to the limited body of research on nosocomial infections in Rwanda, offering a basis for comparison with similar studies in the region. Focusing on specific preventive measures allows for targeted recommendations to improve infection control practices.

Recommendation

- Healthcare providers should ensure strict adherence to all infection prevention guidelines, with particular emphasis on those measures identified as poorly implemented in this study.
- Ongoing training and education programs should be provided to healthcare workers to reinforce the importance of infection control practices.
- Further research should be conducted across multiple institutions and different hospital departments to gain a more comprehensive understanding of nosocomial infection patterns and contributing factors.
- Implementing routine audits and feedback mechanisms could help improve compliance with preventive guidelines and reduce the prevalence of nosocomial infections.

Abbreviation

‰: Percentage

€: Euro currency

BUTH: Butare University Teaching Hospital

CAUTI: Catheter Associated Urinary Tract Infections

CDC: Centers for Disease Control and Prevention

CDI: Clostridioides Difficile Infection

CHUB: Centre Hospitalier Universitaire De Butare

CHUK: Centre Hospitalier Universitaire De Kigali

CLABSI: Central Line-Associated Bloodstream Infections

CMHS: College of Medicine and Health Science

CRBSI: Catheter Related Bloodstream Infection

CSF: Cerebral Spinal Fluid

CVP: Central Venous Pressure

E.coli: Escherichia Coli

ECDC: European Centre for Disease Prevention and Control

ESBL: Extended Spectrum Beta-Lactamase

HAI: Health Care-Associated Infection

HAIS: Hospital Acquired Infections

HCPs: Health Care Providers

HCWS: Healthcare Workers

HMIS: Hospital Management Information System

HOD: Head of Department

ICU: Intensive Care Unit

IV: Intravenous Line

MRSA: Methicillin-Resistant Staphylococcus Aureus

NIS: Nosocomial Infections

Prof: Professor

RMA: Rwanda Military Academy

RDF: Rwanda Defense Force

RMA: Rwanda Military Academy

RMH: Rwanda Military Hospital

R-MPM: Rwanda Mortality Probability Model

SARS-COV-2: Severe Acute Respiratory Syndrome Coronavirus 2

SPSS: Statistical Package for Social Studies

SSI: Surgical Site Infections

UR: University Rwanda

USAID: United States Agency for International Development

UTIS: Urinary Tract Infections

VAP: Ventilator Aspiration Pneumonia

VRE: Vancomycin Resistant Enterococci

WHO: World Health Organization

Author Contributions

All authors conceived and designed the study. Sacré Mubasha carried out the literature review and wrote the manuscript, Hubert Mucyo analyzed the data, and Fabrice Twahirwa participated in the discussion. All authors contributed to manuscript revisions. All authors approved the final version of the manuscript and agreed to make Christian Mukwesi the corresponding author.

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Conflict of Interest

The authors declare that they have no competing interest.

Ethical approval

An ethical approval was obtained from CMHS and RMH research committee.

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Spontaneous termination of unstable ventricular tachycardia in emergency department: A case report

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ABSTRACT

Introduction: Ventricular tachycardia is a type of tachycardia that originates solely from ventricular tissues or Purkinje fibers. Based on its duration, it can be classified as sustained or non-sustained. The standard management of sustained ventricular tachycardia was pharmacologic agents, electrical cardioversion, or ablation therapy. However, in this specific case, sustained ventricular tachycardia was spontaneously converted.

Case report: A 26-year-old male presented with palpitation of one hour and was diagnosed with sustained monomorphic ventricular tachycardia with unstable signs (heart rate of 220 beats per minute). After some while, the symptoms and the abnormal findings were spontaneously terminated.

Conclusion: it is known that sustained monomorphic ventricular tachycardia with unstable signs needs immediate termination with synchronized electrical cardioversion. However, unstable sustained monomorphic ventricular tachycardia in this patient was terminated spontaneously.

Keywords: Ventricular tachycardia, arrhythmia, emergency department, Ethiopia.

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1. Introduction

Ventricular tachycardia is a type of tachycardia (heart rate faster than 100 beats per minute) in which the origin of the driving focus is solely in ventricular tissue or purkinje fibers. Based on the electrocardiographic morphology, it can be categorized as monomorphic ventricular tachycardia & polymorphic ventricular tachycardia⁽¹⁾. Ventricular tachycardia can be diagnosed based on Brugada's algorithm of wide QRS complex tachycardia⁽²⁾. Ventricular tachycardia can also be classified as sustained, which persists for longer than 30 seconds, or hemodynamic instability within the initial 30 seconds, and non-sustained, which lasts for a maximum of 30 seconds^(3,4). For management purpose, ventricular tachycardia is unstable if one of the following features is present: systolic blood pressure below 90 mmHg, altered mentation, ischemic chest pain, shortness of breath, heart rate faster than 200 beats per minute⁽³⁾.

The diagnosis of ventricular tachycardia was associated with structural cardiac disease and prior documented myocardial infarction. However, ventricular tachycardia might be the cause of wide complex tachycardia in 31% of cases without structural heart disease⁽⁵⁾. Sustained ventricular tachycardia was found in 39% of spontaneous ventricular tachycardia in structurally & functionally normal heart⁽⁶⁾. Idiopathic ventricular tachycardia is characterized as monomorphic ventricular tachycardia without structural cardiac disease or coronary artery disease.

In Indonesia, there was a case report on a 32-year-old male presenting with hemodynamic instability and idiopathic left ventricular tachycardia. It was successfully terminated with electrical cardioversion, and radiofrequency ablation was planned with follow-up⁽⁷⁾. The treatment of sustained ventricular tachycardia in the emergency department can be pharmacological and electrical cardioversion. Generally, idiopathic ventricular tachycardia

has a good prognosis with pharmacological treatment or ablation therapy^(1,8).

In Cameroon, a 66-year-old male presented with unstable sustained monomorphic ventricular tachycardia. He passed away after 30 minutes despite being given six tablets of amiodarone, intranasal oxygen, and intravenous fluids. A defibrillator was not available & he was not electrically cardioverted⁽⁹⁾. Electrical cardioversion and stabilization are the prioritized management options for unstable sustained monomorphic ventricular tachycardia. Unstable polymorphic sustained ventricular tachycardia should be terminated with defibrillation (unsynchronized form)⁽¹⁰⁻¹²⁾.

Acute management of patients with ventricular arrhythmia and unstable hemodynamic status aims at immediate termination of ventricular arrhythmia, and early termination of stable ventricular arrhythmia should be warranted as it may lead to decompensation⁽¹³⁾.

In a study done in 30 patients without myocardial disease and with morphologic left bundle branch block & inferior axis, palpitation was felt in 12 patients, dizziness was the main complaint in 13 patients, and syncope was experienced in 7 patients. In this study, two patients had spontaneous resolution of sustained ventricular tachycardia, though it did not mention whether any feature of instability was present or absent⁽¹⁴⁾. Despite the main complaint of our patient being palpitation, spontaneous conversion of sustained ventricular tachycardia with unstable sign was unexpected.

2. Case report

This is a case report of a 26-year-old male who presented on April 06, 2023, at Debre Markos Comprehensive Specialized Hospital emergency room with a complaint of palpitation of one hour duration.

He also had two similar attacks with around 6-month intervals; each episode was identical but

shorter than the current one. Both episodes were relieved without treatment. He had no family history of sudden death, and he did not have any noticed precipitant factor. He did not take any medication and did not undergo any specific maneuvers.

At the time of presentation, his vital signs were in the normal range, except his heart rate was 220, and 12 lead electrocardiography showed ventricular tachycardia (see Fig.1). As he was conscious, he

had to be counseled and sedated for synchronized electrical cardioversion. While he was counseled for the procedure, he said that he just got relieved, and the spontaneous conversion of the rate and the rhythm were visible with the defibrillator and printed electrocardiographic tracing (see Fig 2). He had normal serum electrolyte & renal function tests. Abnormalities were not detected on echocardiography and chest radiography.

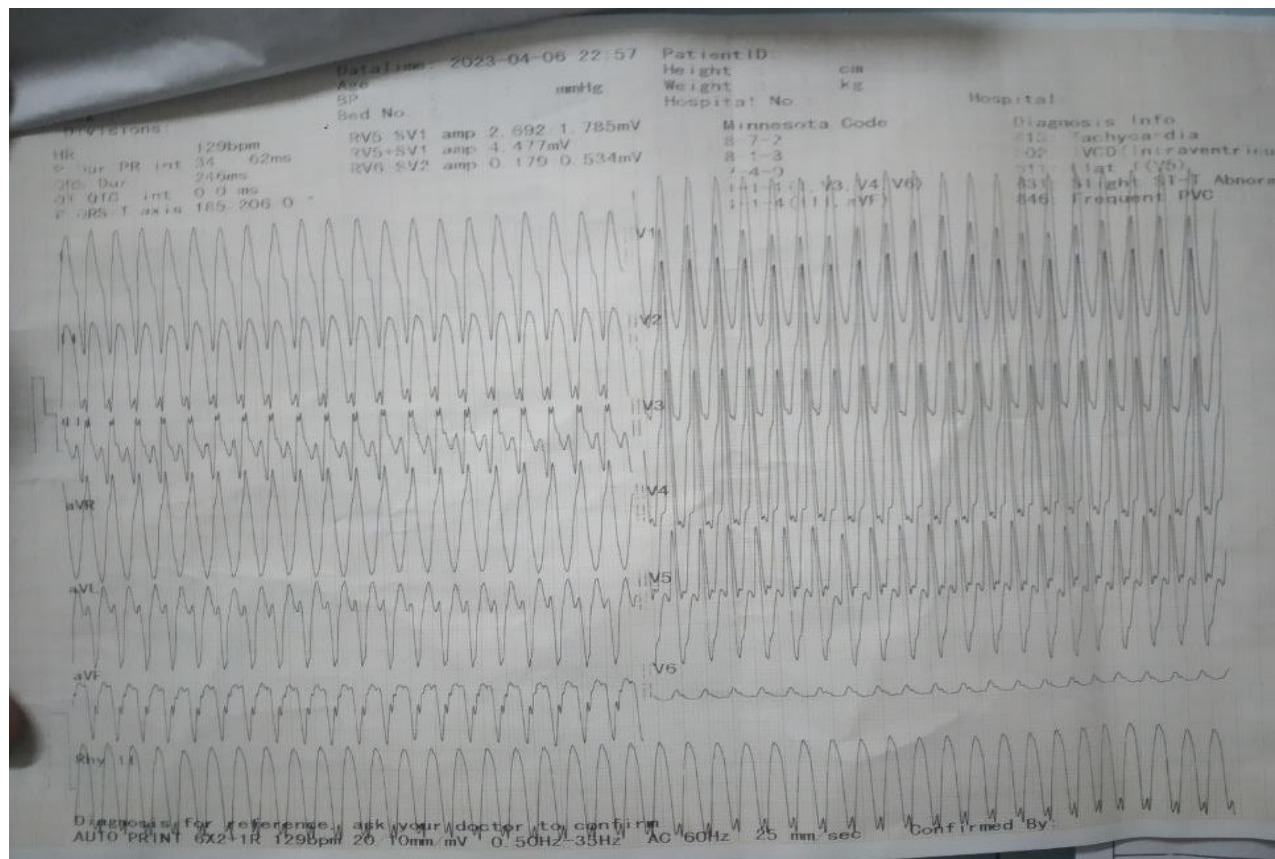


Figure 1: Ventricular tachycardia in 26 years old male with intermittent episodes of palpitation

This is an electrocardiographic tracing with a regular rhythm, a heart rate of 220, and a QRS duration of 140ms with similar morphology, which suggests monomorphic ventricular tachycardia.

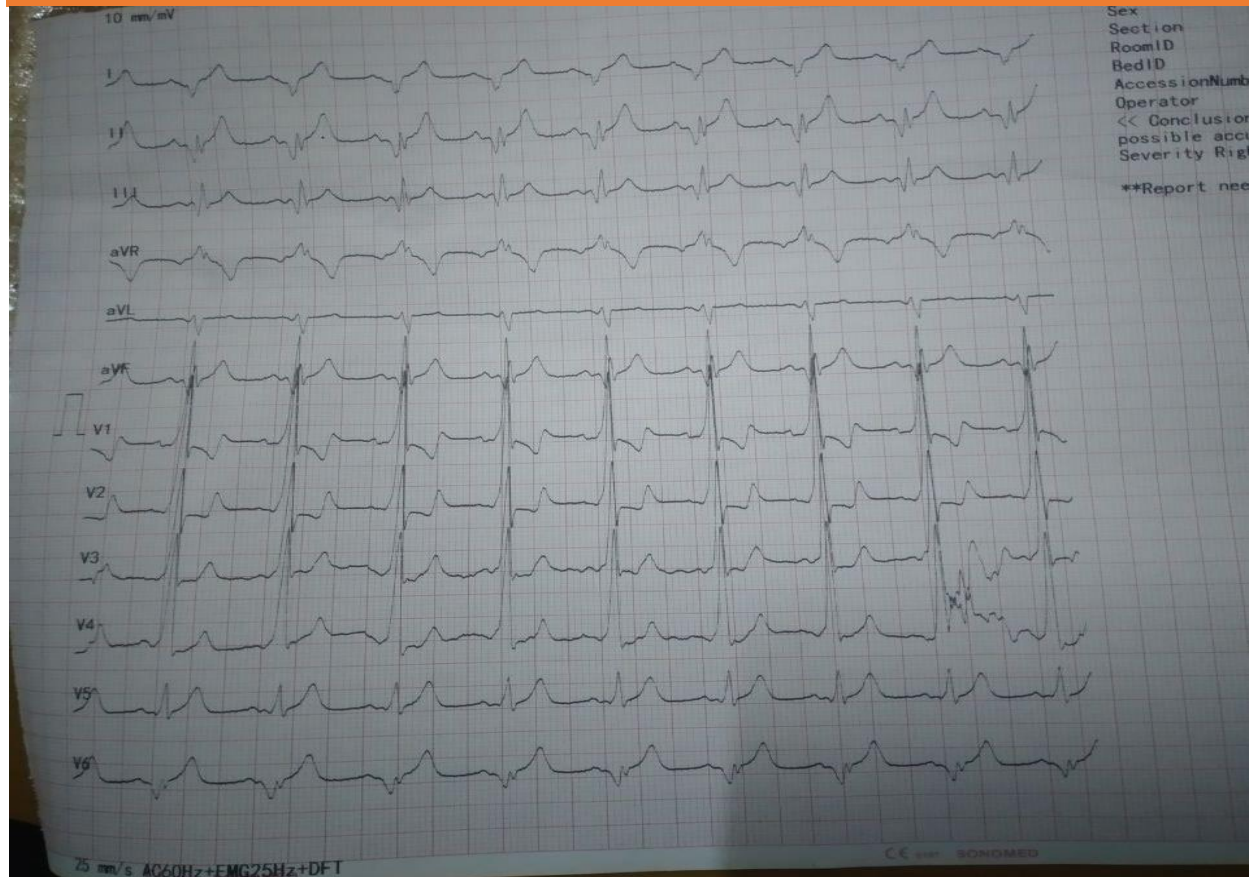


Fig.2: ECG tracing after spontaneous conversion of sustained unstable ventricular tachycardia

This is an electrocardiographic tracing with regular sinus rhythm, heart rate of 100, right axis deviation, QRS duration of 120ms, peaked T wave at leads I, II, V5, V6, Q waves at II, III, avf, V6, ST segment depression at V1-V4.

3. Discussion

The diagnosis of ventricular tachycardia was made based on Brugada's algorithm of wide QRS complex tachycardia⁽²⁾. In our case report, paroxysmal sustained ventricular tachycardia was spontaneously converted. It is against a study done on patients with sustained induced ventricular tachycardia that continued unabated unless terminated with pharmacologic intervention, or programmed stimulation was applied⁽¹⁵⁾. The finding was supported by a study done on 30 patients with sustained ventricular tachycardia, from which two patients experienced spontaneous resolution⁽¹⁴⁾. The disparity was also found in one study that explained the spontaneous resolution of non-sustained ventricular tachycardia

reported in four of seven patients who did not receive antiarrhythmic drugs⁽¹⁶⁾. This may be because the type of ventricular tachycardia is non-sustained and commonly self-resolved.

Our finding is also different from a similar case report in which a 32-year-old male experienced monomorphic ventricular tachycardia with hemodynamic instability, successfully converted with electrical cardioversion⁽⁷⁾. A similar case report of a 66-year-old male who was not saved with amiodarone, intranasal oxygen, and intravenous fluids, but he did not get electrical cardioversion⁽⁹⁾. The reason behind this may be old age and the presence of chronic hypertension. We found that a 26-year-old male patient pre-

sented with monomorphic ventricular tachycardia and a heart rate of 220/minute. The symptoms, heart rate, and cardiac rhythm were spontaneously converted, which deviated from many guidelines and published reports ⁽¹⁰⁻¹³⁾.

4. Conclusions

It is known that the standard management of sustained ventricular tachycardia is pharmacologic, electrical cardioversion, or ablation therapy. First-line emergency management of sustained monomorphic ventricular tachycardia with one of the unstable signs is synchronized electrical cardioversion. Nevertheless, spontaneous termination of sustained monomorphic ventricular tachycardia with unstable sign was found in this case.

Abbreviation

ECG: Electrocardiography

Ms: millisecond

Author Contributions

All authors contributed equally.

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Competing interests

The authors declare that they have no competing interest.

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Spontaneous pneumomediastinum and bilateral subcutaneous emphysema; a rare case presentation in Asthmatic patient

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ABSTRACT

The presence of free air or gas in the mediastinal structures and the pericardial sac without a clear precipitating cause is known as spontaneous mediastinal emphysema (pneumomediastinum) and pneumopericardium. Young, healthy persons without a major underlying lung condition are less likely to experience it. Here, we presented a 15-year-old female known asthmatic patient with sudden onset of shortness of breath, dry cough, and swelling over the neck down to the abdomen. This patient was managed with asthmatic medication and oxygen conservatively and discharged from the hospital with significant improvement. Spontaneous pneumomediastinum should be taken into consideration after excluding common illnesses when a youngster complains of chest pain or tightness. Clinical characteristics and a chest CT scan can be used to diagnose SPM. Most patients with spontaneous pneumomediastinum and subcutaneous emphysema had mild to moderate sequelae and responded well to conservative therapy.

Keywords: Pneumomediastinum, subcutaneous emphysema, asthma

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1. Introduction

Spontaneous pneumomediastinum (SPM) is a rare condition, particularly uncommon in young patients, and it has been historically associated with asthma flare-ups⁽¹⁾. The main causes of SPM include coughing, vomiting, nutritional difficulties, physical activity, and drug use. In some cases, bronchospasm unrelated to asthma can co-exist with SPM. Pneumomediastinum and subcutaneous emphysema are rare side effects of acute asthma. When pneumomediastinum occurs, it can potentially compress vital organs in the mediastinum. Although most cases of SPM are benign and self-limiting, severe cases may require invasive treatments. This case report aims to enhance our knowledge about the treatment options for SPM and subcutaneous emphysema by conducting a comprehensive literature review and assessing their outcomes^(2, 3, 4).

This report outlines the case of a known asthmatic female patient who presented with a Spontaneous Pneumomediastinum and bilateral subcutaneous emphysema to Adama Hospital Medical College in 2024.

2. Case presentation

We present a 15-year-old known asthmatic female patient for the past three years on salbutamol puff PRN presented to our Emergency department with a history of sudden onset of shortness of breath of 1-day duration. The patient started to experience an initial dry intermittent cough after midnight while sleeping, and later on in the same day, she progressively started to witness swelling over her neck, which later began to involve her face, chest, and abdomen until she arrived at our emergency unit. Three days prior to her current complaint, she visited a nearby health

center after she developed a dry cough and SOB, where she was treated with salbutamol puff and unspecified IV medication and discharged home after some improvement of her symptoms. Otherwise, she has no history of fever, trauma to the chest, or previous treatment for TB. She has no previous history of the same complaint and hospital admission for a similar illness.

On her arrival at our Emergency department, the patient was having chest tightness, SOB, and audible wheezing. She looked acutely sick and in cardiorespiratory distress with a blood pressure of 120/80, pulse rate of 124, respiratory rate of 32, a temperature of 37.1 °C, pain score of 3/10, oxygen saturation was 91% with atmospheric air and 95% with Face mask O₂. Other physical examination findings showed she had a swollen face and neck with subcutaneous palpable crepitus; on the chest, there was palpable subcutaneous crepitus over the anterior and lateral aspects and diffuse wheeze all over the lung fields. On abdominal findings, she only had subcutaneous palpable crepitus, and her level of consciousness was intact. She was immediately put on face mask oxygen, and hydrocortisone 200mg IV was loaded. Then 100mg QID, started on salbutamol challenge 6puff Q20min for 2 hours, then Q1hrly with the working diagnosis of severe acute exacerbation of bronchial asthma and grade bilateral spontaneous subcutaneous emphysema with pneumomediastinum.

Her laboratory results were as follows: WBC: 8.5k /UL with neutrophil: 75.6%, lymphocyte: 12.6%, HCT: 46.1%, PLT: 265k/uL, Cr: 0.77mg/dl, ESR: 35mm/hr. Chest radiography showed pneumomediastinum and bilateral subcutaneous emphysema (figure 1- 3)

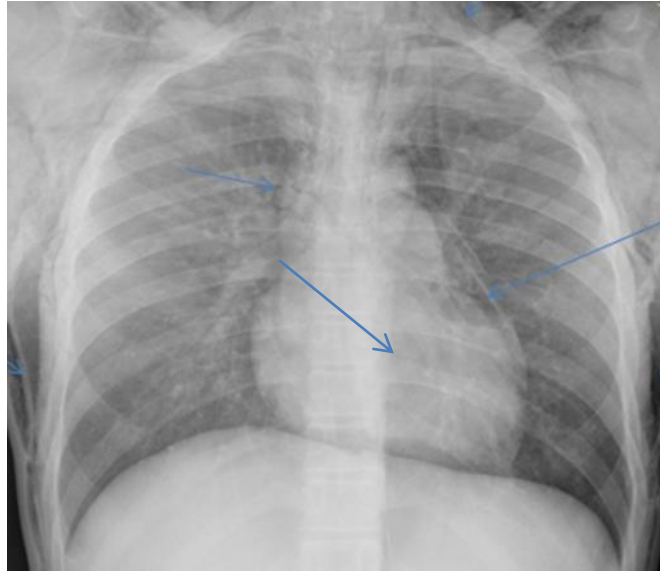


Fig 1: Initial Chest x-ray showing pneumomediastinum and subcutaneous emphysema

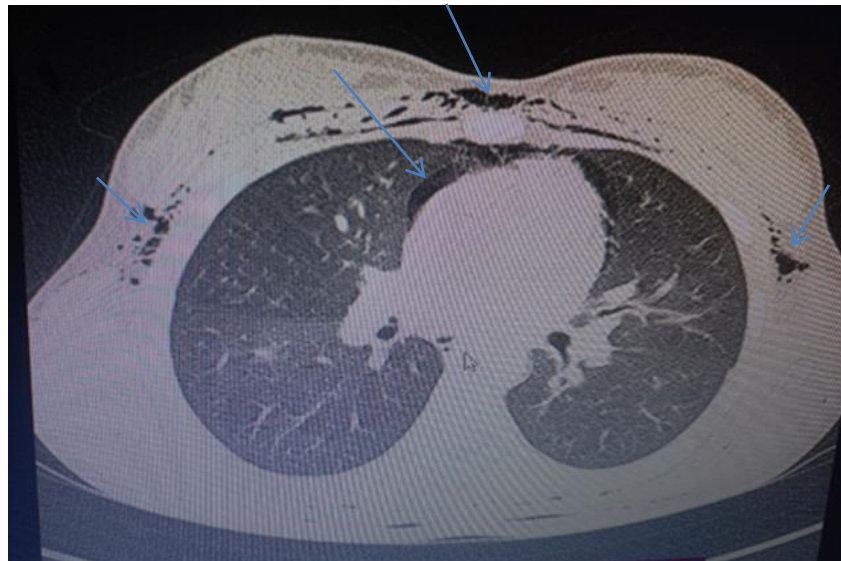


Fig 2: Axial View chest CT scan showing pneumomediastinum and subcutaneous emphysema

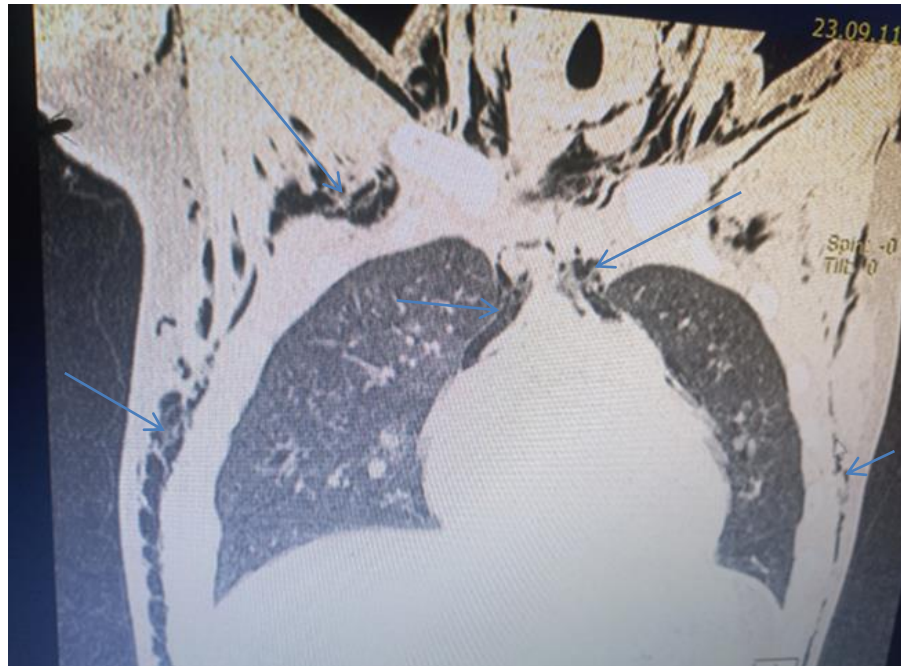


Fig 3: Coronal view of Chest CT scans showing pneumomediastinum and subcutaneous emphysema

The patient was subsequently treated with FMO2, hydrocortisone 100mg IV QID salbutamol puff. She was treated only with medical management for 7 days and then discharged to her home

with symptom improvement. On discharge, the patient's chest radiography was repeated, which showed significant improvement from the initial imaging, as shown in Figure 4.



Fig 4: Control chest X-ray after one week with complete resolution of the pneumomediastinum and subcutaneous emphysema

3. Discussion

Pneumomediastinum can be caused by three different mechanisms: a ruptured alveolus, a dis-

ruption of a cutaneous or mucosal barrier (typically the tracheobronchial tree or the esophagus), or a disruption of a cutaneous or mucosal barrier that allows gas to enter the mediastinum

Uncommon, self-limiting illness called spontaneous pneumomediastinum causes air to accumulate in the mediastinum for no apparent reason. SPM has been linked to a wide range of diseases and causes, including coughing, bronchial asthma, diabetic ketoacidosis, vigorous exercise straining, medication inhalation, delivery, violent coughing or vomiting, and other activities related to the Valsalva maneuver. According to recent case reports, SPM has also happened to people with gastric reflux disease, anorexia nervosa, when someone swallowed a foreign object like a peach seed or a pig rib, and in a patient who did yoga ^(5, 6).

An uncommon side effect of acute severe asthma, subcutaneous emphysema can develop in conjunction with spontaneous pneumomediastinum, pneumopericardium, or pneumoperitoneum. An abrupt increase in intra-alveolar pressure (caused by asthma, the vasalva maneuver, coughing, emesis, or barotraumas) causes the rupture of the marginal alveoli, which leads to the tracking of air along the bronchi, interstitial tissues, and vascular support tissues into the mediastinum. Subcutaneous cervico-facial emphysema can be caused by itinerant air molecules entering the pleural, pericardial, peritoneal space, soft tissues of the face, neck, or upper trunk. Due to the air escaping from the alveolar gaps, there is an imbalance between ventilation and perfusion, which leads to improper arterial blood oxygenation. Rapid ascent to the water is another reason for air extravasations into extrapulmonary structures ⁽⁷⁾.

Even though they are typically asymptomatic, pneumomediastinum and pneumopericardium can cause neck and chest pain, dysphonia, and shortness of breath. Treatment is supportive unless the patient has a history of trauma from as-

pirating a foreign body. The course of spontaneous pneumomediastinum and pneumopericardium is typically benign and self-limited ^(8, 9).

Making a diagnosis of SPM only requires the sudden start of the characteristic symptoms, the presence of a predisposing condition, and the use of CT to rule out any other potential causes of pneumomediastinum. SPM should be taken into consideration after excluding out common illnesses when a youngster complains of chest pain or tightness. Clinical characteristics and a chest CT scan can be used to diagnose SPM. Clinical characteristics and a chest CT scan can be used to diagnose SPM; this entity does not require surgical intervention to be treated. The evolution is generally benign, which justifies a cautious approach ^(10, 11, 12).

4. Conclusions

Spontaneous subcutaneous emphysema and pneumomediastinum are rare presentations in Asthmatic patients. This entity is usually treated with conservative treatment like control acute asthmatic control oxygen therapy, and most of the time, it responds to conservative therapy without any surgical intervention.

Conflict of Interest

The authors declare that they have no competing interest

Ethical approval

I certify that the study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. The ethical board of Adama Hospital Medical College exempts the study from ethical approval in our institution. The patient gave written informed consent to publish this case report and accompanying images. A copy of the written consent form is available for review by the editor-in-chief of this journal upon request.

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Atrial fibrillation with Slow Ventricular response as a sign of Digoxin Toxicity Secondary to Acute Renal failure

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ABSTRACT

Introduction: Digoxin is a cardiac glycoside that has been used for centuries for atrial fibrillation (AFib) and congestive heart failure (CHF). Digoxin has a narrow therapeutic index with a potential for toxicity that can be life-threatening. Toxicity can result from accidental or intentional overdose, renal failure, and/or hypokalemia. Cardiac manifestations of digoxin toxicity cause dysrhythmias of different types. Bidirectional ventricular tachycardia is a specific dysrhythmia in the setting of digitalis toxicity, but AFib with slow ventricular response (SVR) is another digoxin toxicity-related dysrhythmia.

Case report: Here, we report AFib with SVR as a sign of digoxin toxicity secondary to acute renal failure (ARF).

Conclusion: The presence of AFib with SVR should trigger a search for digoxin toxicity. Every effort should be made to thoroughly review the patient's medications by reviewing the medical record and contacting the primary care physician as most patients do not present with their medications or an accurate medication list and the electronic record may not reflect current medications. The digoxin level should be obtained.

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Keywords: ECG, digoxin, renal failure, toxicity

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1. Introduction

Digoxin is a cardiac glycoside that has been used for centuries for atrial fibrillation (AFib) and congestive heart failure (CHF). Digoxin exerts its effect by reversibly inhibiting the sodium-potassium adenosine triphosphatase (ATPase) on the cardiomyocyte. This mechanism increases the calcium level and leads to an increased inotropic effect, hence its use in congestive heart failure (CHF) ^(1,4,5). Another effect of digoxin is increased vagal tone, which is utilized to treat AFib ^(3,8,9). There is controversy regarding its use for AFib. Digoxin has a narrow therapeutic index with a potential for toxicity that can be life-threatening. Toxicity can result from accidental or intentional overdose, renal failure, and/or hypokalemia. Cardiac manifestations of digoxin toxicity cause dysrhythmias of different types. Bidirectional ventricular tachycardia is a specific dysrhythmia in the setting of digitalis toxicity, but AFib with slow ventricular response (SVR) is another digoxin toxicity-related dysrhythmia.

The mechanisms of toxicity are not fully understood, but several mechanisms have been suggested as contributory pathways ^(6, 10, 11). One such mechanism includes increased vagal tone leading to bradycardia and various Atrioventricular blocks ^(12,13).

2. Case report

A 73-year-old female patient presented at the emergency department (ED) for a slow heart rate evaluation. The patient had an increase in liver enzymes and a suspicious mass on a computed tomography (CT) scan of the abdomen and pelvis and was referred for a liver biopsy. The patient presented at the ambulatory surgery office, and a low heart rate triggered the transfer to ED. In the ED,

the patient reported mild to moderate and intermittent chest pressure. Pain is non-radiating, but she could not state how long she has had it. The patient also reported mild shortness of breath and generalized weakness due to watery diarrhea for two weeks with poor oral intake. She denied vomiting, abdominal pain, fever, cough, weakness in extremities, speech, or vision changes. The patient has a history of alcohol use disorder and smokes cigarettes. Past medical history included myasthenia gravis, coronary artery disease, liver cirrhosis, diet-managed diabetes mellitus, and AFib. The medication list included 250 micrograms of digoxin oral daily, 50 mg metoprolol oral daily, 40mg omeprazole oral daily, 20mg prednisone oral daily, 300 mg ursodiol two pills oral twice a day, 20 milliequivalent KCL oral daily, 40 mg furosemide oral daily, 2.5mg metolazone oral daily, and 60 mg pyridostigmine oral daily. The patient had no past surgical history but reported a penicillin allergy.

Physical examination in the ED was as follows: vitals BP 119/70 mmHg, HR 33 beats per minute (peripheral heart rate), RR 16 breaths per minute, oxygen saturation of 96% on room air, and finger stick glucose of 130 mg/dL.

The patient had no visible distress, lungs were clear to auscultation bilaterally, irregularly irregular heartbeat with a rate of 33 beats per minute, no murmurs, scleral icterus, (+) 2 bilateral lower extremities edema, no jugular vein distention (JVD). Her ECG showed AFib with an SVR of 38 beats per minute (Figure 1). The patient was given normal saline, external pacemaker pads were placed in case pacing or defibrillation was needed, and a trial with 0.5mg atropine intravenous with minimal increase in the heart rate.

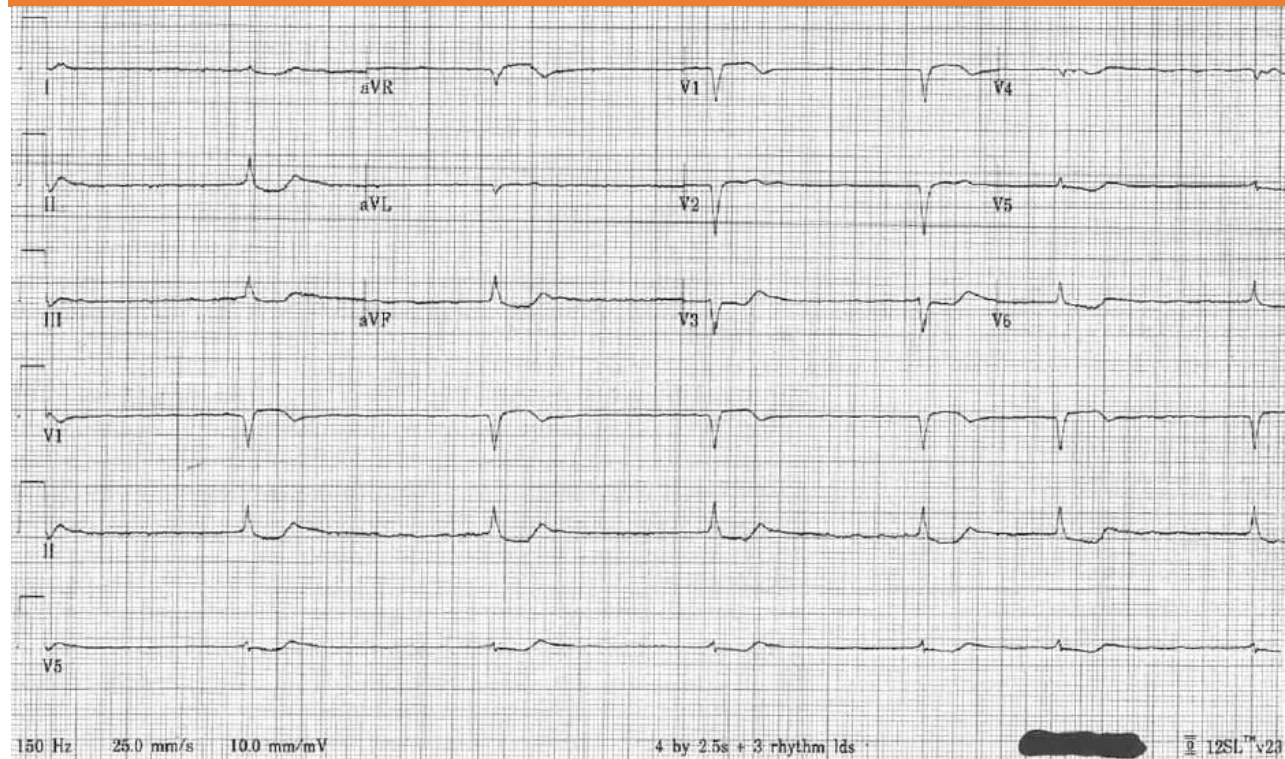


Figure 2: ECG showing atrial fibrillation with a slow ventricular response

Laboratory workup demonstrated creatinine of 3.5 mg/dL, BUN 120 mg/dL, potassium of 4.7 mmol/mL, and digoxin level of 5 ng/mL. Liver function test showed albumin of 2.8 g/dL, total bilirubin 4.7 mg/dL, direct bilirubin 3.0 mg/dL, and international normalized ratio (INR) 1.8. Cardiology and renal services were consulted and supportive care with intravenous fluid, monitoring of electrolytes, and withholding digoxin was recommended without digoxin-specific antibody. During the course of her hospital stay the creatinine improved and the patient was discharged to home in improved condition.

3. Discussion

Digoxin exerts its effect by reversibly inhibiting the sodium-potassium adenosine triphosphatase (ATPase) on the cardiomyocyte. This mechanism increases the calcium level and leads to an increased inotropic effect, hence its use in congestive heart failure (CHF) ^(1,4,5). Another effect of digoxin is increased vagal tone, which is utilized

to treat AFib ^(3,8,9). There is controversy regarding its use for AFib. The mechanisms of toxicity are not fully understood, but several mechanisms have been suggested as contributory pathways ^(6,10,11). One such mechanism includes increased vagal tone leading to bradycardia and various Atrioventricular blocks ^(12,13).

Digoxin toxicity can occur for several reasons including accidental or intentional overdose, renal failure as a result of fluid loss due to gastroenteritis, or electrolyte imbalance such as hypokalemia ^(10,14-19). The renal effect can be worsened in elderly patients with CHF ^(17,20-22). The clinical symptoms of digoxin toxicity are nonspecific and may mimic any other disease, but the cardiac effect may give a clue that the patient may have digoxin toxicity. The cardiac effects may manifest as dysrhythmia, such as AFib with SVR or biventricular tachycardia ⁽²³⁾.

Our patient was on several antidiuretic medications and had two weeks of diarrhea, which compromised the renal function, leading to the accumulation of digoxin in the body. The digoxin renal clearance varies linearly with the renal function, leading to toxicity in patients with ARF despite regular digoxin doses. The renal dysfunction can be further exacerbated in the setting of volume depletion and CHF, particularly in geriatric patients.

Treatment of digoxin toxicity includes management of the underlying condition of renal failure and electrolyte imbalance and temporarily holding the digoxin dose. A special digoxin-binding antibody should be given in selected cases of very high digoxin levels, hyperkalemia, hemodynamic instability, and tachyarrhythmia. Indications of Digi bind are hyperkalemia greater than 5mmol/mL, cardiac arrest, life-threatening dysrhythmia, and > 10mg ingestion or digoxin level greater than 12 ng/mL⁽²⁴⁾.

This patient presented with a slow heart rate and her ECG showed AFib. Further, the workup showed acute renal failure with a high digoxin level. The patient was managed medically with a multidisciplinary approach, including cardiology and nephrology consultations, and her renal function improved.

The important point of the case is identifying the low heart rate and the presence of AFib with SVR. Patients are evaluated by different providers with varying experiences, including ECG reading, emphasizing this pathological ECG and its association with digoxin toxicity. Considering bradycardia as just an effect of digoxin and not entertaining digoxin toxicity may lead to further exposure to digoxin and life-threatening dysrhythmia.

4. Conclusions

The presence of AFib with SVR should trigger a search for digoxin toxicity. Every effort should be made to thoroughly review the patient's medications by reviewing the medical record and contacting the primary care physician as most patients do not present with their medications or an accurate medication list and the electronic record may not reflect current medications. The digoxin level should be obtained.

Abbreviation

Afib=Atrial Fibrillation

CHF=Congestive Heart Failure

CT= Computed Tomography

ECG= Electrocardiogram

ED= Emergency Department

INR = International Normalized Ratio

JVD=Jugular Vein Distention

SVR=Slow Ventricular Response

Competing interests

The authors declare that they have no competing interest

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Amitraz Poisoning: A Review of the Literature and Case Report

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ABSTRACT

Background: Amitraz poisoning, though rare, poses significant health risks, particularly in developing regions like Africa, where its use as an insecticide is widespread.

Case Presentation: A 24-year-old female in Uganda was brought to the Emergency Department after intentional ingestion of Amitraz. The assessment revealed somnolence, bradycardia, normotension, and respiratory distress. Despite decontamination, intravenous fluids, and atropine administration, the patient's condition deteriorated, necessitating intubation and ICU transfer.

Discussion: Amitraz toxicity manifests primarily through central α_2 adrenergic receptor agonism, with symptoms including hypotension, bradycardia, altered mental status, and respiratory depression. Differentiating Amitraz poisoning from organophosphate poisoning is crucial due to overlapping features but distinct management strategies. Supportive care, including airway management, is essential.

Conclusion: This case highlights the need for understanding of Amitraz poisoning in resource-limited settings. Effective supportive care can lead to successful outcomes despite severe initial presentations. Further education and preventive measures are recommended to mitigate risks, especially among vulnerable populations.

Keywords: Amitraz, Overdose, Toxicity, Central α_2 adrenergic receptor agonism, Resource limited

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1. Introduction

Amitraz is an insecticide and acaricide widely used in agriculture and veterinary medicine, particularly for the control of ectoparasites such as ticks and mites in livestock. Although Amitraz poisoning is relatively uncommon compared to other pesticide exposures, it poses a significant public health risk, particularly in regions where its use is prevalent, such as Africa and parts of Asia.¹ The toxicity of Amitraz is primarily due to its action as a central $\alpha 2$ adrenergic receptor agonist, leading to clinical features that overlap with other types of pesticide poisoning, notably organophosphates. This overlap can create diagnostic and therapeutic challenges, especially in resource-limited settings where access to advanced diagnostic tools and intensive care facilities may be limited.

Amitraz poisoning typically presents with central nervous system depression, respiratory distress, bradycardia, and hypotension. In more severe cases, patients may develop respiratory failure, requiring advanced airway management and intensive supportive care. The management of Amitraz poisoning is largely supportive, as no specific

antidote is available. Early recognition of the toxicity and differentiation from other pesticide poisonings, such as organophosphates, is crucial to guiding appropriate treatment.

This report presents a case of intentional Amitraz ingestion in a 24-year-old female in Uganda, highlighting the clinical features, diagnostic challenges, and management in a resource-limited environment. We also provide a review of the literature on Amitraz poisoning, focusing on its pathophysiology, clinical manifestations, and management strategies in the emergency setting.

2. Case report

A 24-year-old female was brought into the Emergency Department at a referral center in Southwest Uganda by her neighbors with a history of intentional Amitraz ingestion. She was last seen 1.5 hours before she arrived at the hospital, entering her house. She was subsequently found approximately 1 hour before the Emergency Department arrival by her neighbor on the ground in her room with a reduced level of consciousness and a 100ml empty bottle of Bimatraz (Amitraz) by her side (Figure 1). No other history was available from the patient's neighbor.



Fig 1: 100 mL bottle of Bimatraz (Amitraz) 12.5% emulsifiable solution

On initial evaluation, the patient was somnolent but aroused to sternal rub. Her temperature was 36.4 degrees Celsius; her heart rate was 60 beats per minute; her blood pressure was 143/87 mmHg; her respiratory rate was 20 breaths per minute; and her SpO₂ was 100% on room air. Her airway was clear and patent without secretions. Lungs were clear to auscultation bilaterally. Extremities were warm and well-perfused. GCS was 12; pupils were pinpoint, symmetric, and sluggishly reactive to light bilaterally. There were no obvious signs of trauma to the head, neck, torso, or extremities. The skin was dry. There were no signs of urination or lacrimation. Intravenous access was established, and she was put on supplemental oxygen. The patient was decontaminated, and her clothes were removed. She was washed with soapy water. An NG tube was placed, and gastric lavage was performed with aspiration of 300ml of whitish residue mixed with gastric contents. A 500ml IV fluid bolus was administered. A fingerstick blood glucose was 3.3mmol/L (60mg/dL). The patient was given 25g of intravenous dextrose. A 12-lead EKG was performed, and normal sinus rhythm was demonstrated at normal intervals, with no signs of active ischemia. A urine pregnancy test was performed, and it was negative.

Despite initial resuscitation, the patient's mental status and respiratory status continued to decline. One hour after the initial presentation, her GCS was 8, she had sonorous respirations with crackles in bilateral lung fields, SpO₂ had decreased to 80% on 4L by nasal cannula, and her respiratory rate had increased to 40. Blood pressure was 139/90 mmHg, and heart rate was 113 beats per minute. An oropharyngeal airway was placed. Given the reduced level of consciousness and miosis as well as her initial presenting brady-

cardia, it was felt there could potentially be a concern for co-ingestion with organophosphate, and as such, she was given 2mg of Atropine, which was doubled until reaching 16mg, at which point she was felt to be atropinized. She was subsequently placed on a non-rebreather, and her oxygen saturation initially improved to 94%, but this was transient, and shortly thereafter, she was again hypoxic shortly thereafter. The decision to intubate the patient was complicated by resource limitations, specifically the fact that there were no available intensive care unit (ICU) beds at the hospital at that time. An ICU bed was ultimately secured at an outside facility, and the patient was immediately intubated and sedated with ketamine. She was transferred to the outside facility ICU without complication, but her follow-up care was unobtainable.

3. Discussion

Amitraz is an insecticide and acaricide commonly used worldwide, including widespread use in Africa⁽¹⁾. The majority of Amitraz poisonings occur through ingestion; however, toxicity is also possible through inhalation and dermal absorption. Following oral administration, Amitraz is absorbed rapidly in the GI tract, has a wide distribution, and its metabolites are excreted in the urine. In addition to Amitraz's toxicity, it is often prepared in hydrocarbon solvents like xylene⁽¹⁾. Ingestion of hydrocarbons alone can cause CNS depression, respiratory depression, coma, and ataxia. Aspiration during hydrocarbon ingestion can also cause significant pulmonary toxicity. A 2-year survey conducted in South Africa demonstrated that poisoning most often occurred in children, with most ingestions being accidental. Poisoning rates were lower among adults; however, a significant portion of adult ingestions (60%) were intentional⁽²⁾.

Numerous mechanisms have been proposed for Amitraz toxicity. These include α_2 adrenergic receptor agonism, voltage-dependent calcium ion (Ca^{2+}) channel agonism, prostaglandin synthetase inhibition, monoamine oxidase (MAO) inhibition, adenylyl cyclase inhibition, and the generation of reactive oxygen species.³ In humans, the primary manifestation of Amitraz toxicity, and indeed morbidity and mortality, is through central α_2 adrenergic receptor agonism, behaving similarly to the antihypertensive medication clonidine⁽³⁾.

Clinical manifestations of Amitraz poisoning typically involve hypotension, bradycardia, miosis (more commonly, but mydriasis has also been reported), altered mental status, vomiting, convulsions, polyuria, gastrointestinal hypomotility, and hyperglycemia.⁽¹⁾ The majority of these actions are likely through agonism of the central α_2 adrenergic receptors, although it is hypothesized that inhibition of H1 receptors can contribute to decreased intestinal motility, cell death, seizures, and anti-inflammatory effects⁽³⁾.

There is no specific antidote for Amitraz poisoning, and management mainly consists of supportive and symptomatic care⁽⁴⁾. Maintaining a patent airway and adequate ventilation is one of the most important measures. Supportive therapy includes the administration of supplemental oxygen, airway management, fluid resuscitation, and vasopressor support if needed. Inotropic agents may be used if hypotension is refractory to fluid repletion. Transient peripheral α_2 receptor antagonism may also occur, resulting in transient hypertension, which is typically short-lived and will progress back to hypotension⁽⁵⁾. As this hypertension is typically a brief, transient effect, we do not recommend the routine treatment of hypertension in Amitraz overdose. Atropine may be added to the treatment regimen if hemodynami-

cally significant bradycardia occurs. Benzodiazepines or barbiturates may be useful in cases of seizures⁽⁵⁾. In cases of profound somnolence, patients may require intubation; however, the patient's mental status frequently improves with tactile or auditory stimulation, which may help avoid unnecessary intubations, which is significantly beneficial in resource-limited settings.

One of the main clinical challenges with Amitraz poisoning is the overlapping clinical features of other toxic ingestions, including organophosphates. Both Amitraz and organophosphate ingestion cause hypotension, bradycardia, altered mental status, and miosis, which can lead to misdiagnosis and mismanagement of the intoxication⁽⁶⁾. However, the presence of hyperglycemia, hypothermia, and reduced gastrointestinal motility, along with the absence of salivation, lacrimation, perspiration, and diarrhea, help to distinguish Amitraz ingestion from organophosphate poisoning⁽⁶⁾. In our clinical experience, the administration of atropine to patients with Amitraz toxicity frequently results in significant tachycardia and hypertension. As in our case, this distinction can be challenging, and the treating team was ultimately concerned about possible organophosphate co-ingestion and, therefore, attempted atropine administration. In retrospect, all of the patient's clinical features were consistent with Amitraz ingestion, and co-ingestion with organophosphates was unlikely given the lack of persistent bradycardia, hypotension, salivation, lacrimation, perspiration, and diarrhea. Nevertheless, the initial decision to decontaminate the patient was made as organophosphate ingestion was on the initial differential diagnosis and therefore it was felt prudent to do so. Regarding the patient's tachypnea and respiratory distress, which are atypical for pure Amitraz ingestion, we felt this was likely due to aspiration. In the setting of Amitraz poisoning, aspiration is secondary to either

the presence of hydrocarbon solvent within Amitraz solution or simply from the patients' prolonged obtundation resulting in aspiration. In either event, tachypnea and respiratory distress are not classic features of pure Amitraz ingestion, and when present, the possibility of an alternate diagnosis, co-ingestion, and/or aspiration must be considered.

Data regarding Amitraz intoxication in humans is limited, and ingestions are mainly seen in accidental ingestions in pediatrics and suicidal ingestions by adults. Herath, Pahalamagame et al. reported a case of a 20-year-old female who presented to the hospital following ingestion of Amitraz. Gastric lavage, intravenous fluids, and intravenous dopamine were given to the patient, who fully recovered within 48 hours ⁽⁷⁾. Another case report by Shilpakar, Karki et al. reported a 27-year-old male who presented to the hospital with Amitraz intoxication. The patient recovered and was discharged following supportive management with intravenous fluids and atropine ⁽⁸⁾.

Amitraz poisoning is a worldwide problem that disproportionately affects the developing world. The majority of these ingestions are unintentional by children, but more significant morbidity and mortality are associated with intentional ingestion by adults. Although Amitraz ingestion is rare, it can lead to serious cardiovascular and neurological complications. Treatment is generally supportive in nature, and there is no specific antidote. Despite potentially life-threatening complications, according to case reports in the literature, patients can be managed successfully with good supportive cardiovascular and respiratory care.

4. Conclusions

Amitraz poisoning, though rare, can lead to life-threatening complications, particularly in resource-limited settings where diagnostic and

therapeutic options may be constrained. This case demonstrates the importance of early recognition and differentiation from other pesticide poisonings, such as organophosphates, due to overlapping clinical features but distinct management protocols. The patient's progression to respiratory failure underscores the need for vigilant airway management and close monitoring of respiratory status in cases of severe poisoning.

Although there is no specific antidote for Amitraz poisoning, prompt supportive care—particularly airway management and hemodynamic support—can lead to favorable outcomes, even in severe cases. Further education on the risks of Amitraz exposure, as well as preventive measures to limit accidental or intentional ingestion, is essential, particularly in regions where its use is widespread. This case and review highlight the need for improved awareness and preparedness to manage pesticide poisonings effectively, particularly in resource-constrained environments where these exposures may be more common.

Abbreviation

GCS: Glasgow Coma Scale
IV: Intravenous
NG tube: Nasogastric tube
EKG: Electrocardiogram
SpO₂: Peripheral capillary oxygen saturation
ICU: Intensive Care Unit
CNS: Central Nervous System
MAO: Monoamine Oxidase
H₁ receptor: Histamine 1 receptor
Ca²⁺: Calcium ion

Conflict of Interest

The authors declare that they have no competing interest

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Traumatic Tension Pneumocephalus with Mount Fuji sign and air bubble sign: A case report

Ephrem Basaznew^{1*}, Sofia Kebede¹, Kalkidan Kebede¹, Eyouel Elias¹, Getachew Abebe¹

ABSTRACT

Introduction: Tension Pneumocephalus is a rare but life-threatening neurosurgical emergency that may need urgent surgical intervention. For diagnosis, brain imaging, preferably a brain CT scan, is mandatory.

Case Presentation: We present a rare case of post-traumatic tension pneumocephalus in a 40-year-old Ethiopian man who sustained a road traffic accident, and clinical deterioration occurred after 12 hours. A brain CT scan shows the Mount Fuji and air bubble signs, typical signs of tension pneumocephalus. The emergency burr-hole evacuation was carried out. After the procedure, the patient was followed by a control lateral skull x-ray and then discharged after ten days of hospital stay with a GCS of 15.

Conclusion: Tension Pneumocephalus is a clinical diagnosis. A history with brain imaging can easily diagnose it, but invasive surgical intervention may be mandatory to overcome the problem. Knowledge of risk factors, radiographic findings, and clinical signs/symptoms associated with Tension Pneumocephalus is crucial to its prompt identification and treatment. This case shows the importance of considering tension pneumocephalus for any patient presenting with headache and altered mental status after sustained trauma.

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Key words: Tension Pneumocephalus, Mount Fuji sign, air bubble sign

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1. Introduction

Pneumocephalus (Intracranial aerocele) is the presence of air within the intracranial cavity. The first description of intracranial pneumocephalus provided by Thomas in 1866 was discovered during the autopsy of a trauma patient ⁽¹⁾. Lockett used plain skull radiographs in 1913 to diagnose pneumocephalus ⁽²⁾. The term pneumocephalus was coined and first used by Wolff in 1914 ⁽³⁾. The gas may be located in epidural, subdural, sub-arachnoid, intraparenchymal, or intraventricular. The common site is frontal, followed by the occipital and temporal areas. It could be acute (<72 h) or delayed (≥ 72 h), or it can also be classified as simple or tension pneumocephalus (4). Anything that can cause a CSF leak can produce associated pneumocephalus like Trauma, Neurosurgical procedures, congenital skull defects, and Infections with gas-producing organisms ⁽⁵⁻⁸⁾. A report of 295 cases shows that the most common cause of tension pneumocephalus is trauma, accounting for 75% of the study population ⁽⁹⁾. Complications could occur when the intracranial air collection significantly increases intracranial pressure (ICP), causing subsequent neurological deterioration ⁽¹⁰⁾. This emergency is identified as traumatic tension pneumocephalus, a serious complication that could lead to progressive brain compression, brain oxygen supply reduction, and brain herniation ⁽¹¹⁾.

2. Case presentation

A 40-year-old presented to the emergency department following a road traffic accident. He was a pedestrian, but the details of the injury are unknown. The patient had significant bleeding from the head and slight bleeding from both ears. Following the accident, he was taken to a nearby health center, the bleeding was arrested, the laceration was repaired, and TAT was administered before he returned to his home. After 12 hours stayed at home, he developed irritability and severe headaches, prompting his family to bring him to Tikur Anbesa Hospital in Addis Ababa, Ethiopia. At Tikur Anbesa Hospital, his vital signs were unremarkable, except his Pulse rate was 112. On examination, he had pale conjunctiva, with wounds repaired on the left lateral canthus, left supraorbital area, and occipital area. His Glasgow Coma Scale (GCS) score was 13 (E=3 V=4 M=6). Pupils were midsized and reactive to light. No cranial nerves, motor, or sensory deficits were detected.

Laboratory findings:

RBS = 53 mg/dl, CBC (WBC = 12,500 (Neutrophil count of 84.1%), Hgb = 6.2 (MCV of 96.5 fl), Hct = 19.3, Plt = 146,000, RFT: creatinine = 1.03mg/dl, urea = 24.7mg/dl, Electrolytes: Na = 140, K = 3.21, Cl = 115.2

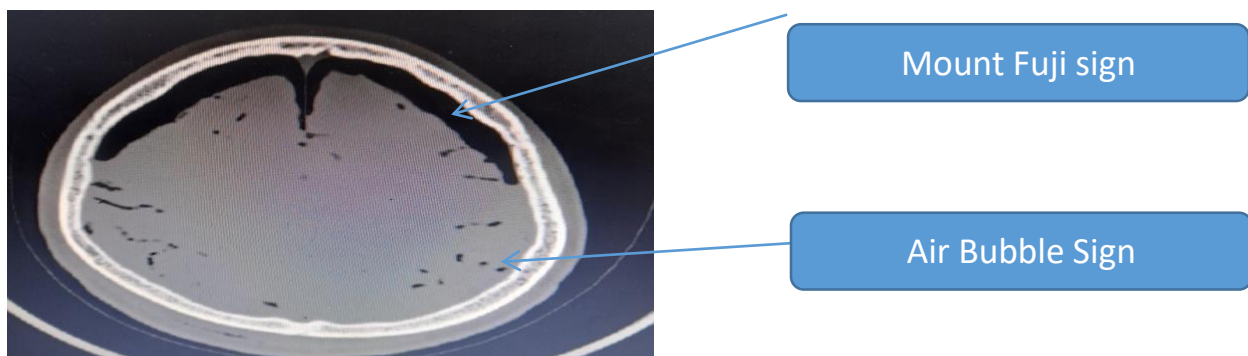
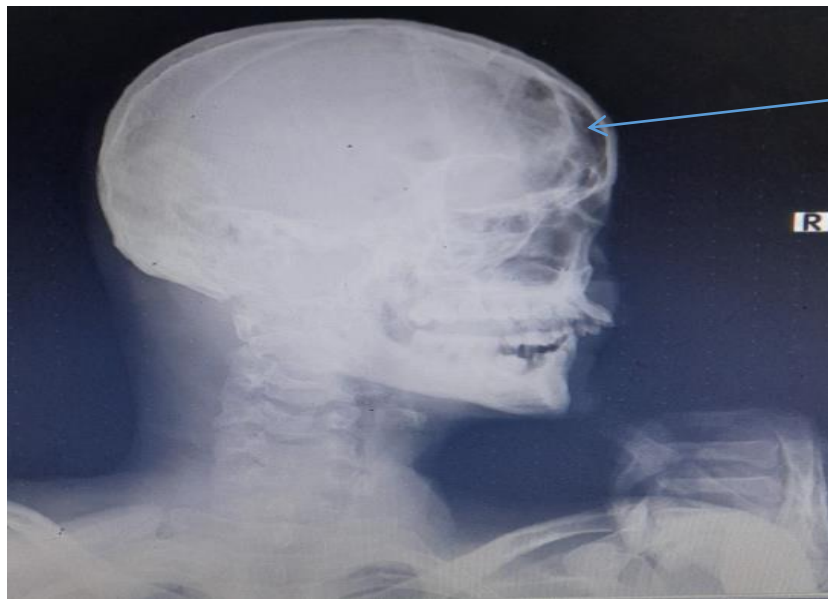


Figure 1: Mount Fuji sign and Air bubble sign, On Brain CT Scan of the Patient



Radiolucent Area

Figure 2: Control Skull radiograph taken one day post op shows a radiolucent area over the frontal region of the head in the lateral view.



Radiolucent disappear

Figure 3: Control lateral skull x-ray of the patient 3 days after the operation shows a radiolucent area disappear

3. Discussion

This report presents 12 hours after a sustained road traffic accident, and the patient had developed tension pneumocephalus. We present this case to increase awareness about Tension Pneumocephalus. If not recognized early, tension

pneumocephalus can be devastating, leading to poor neurologic outcomes and mortality. Tension Pneumocephalus is a rare but life-threatening neurosurgical emergency that is intracranial equivalent of Tension pneumothorax. It is a type of pneumocephalus in which intracranial air causes mass effect and increased intracranial

pressure. The ball valve theory of Dandy and Horowitz's inverted soda bottle effect are among the well-known pathophysiological mechanisms of tension pneumocephalus; first, one describes a unidirectional air movement from outside into the cranial cavity, which then gets trapped. The second theory tells that negative intracranial pressure (ICP) occurs as a result of excessive CSF loss due to any mechanism, for example, drainage in a physiological way during the Valsalva maneuver or through the iatrogenic lumbar drain ⁽¹²⁻¹⁴⁾.

Tension pneumocephalus is diagnosed by a combination of typical CT brain findings, neurological deterioration, the hissing sound of air escaping during the procedure, and immediate improvement in the neurological status upon aspiration of/letting out air. If patient safety measures are meticulously adapted by care providers without compromising steps, such neurosurgical emergencies can be avoided ⁽¹⁵⁾.

Patients with Tension pneumocephalus usually present with severe headaches, Nausea and Vomiting, seizures, dizziness, and altered mental status ⁽¹⁶⁾. An intracranial succussion splash is a rare but pathognomonic finding. A minority of patients describe 'bruit hydroaerique' (a splashing noise on head movement, equivalent to the succussion splash of pyloric stenosis). Others may present with signs and symptoms like any mass, which may cause focal deficit or increased ICP. CT scan is the primary imaging modality used to diagnose tension pneumocephalus, where air appears darker than CSF, with attenuation values of 1000 Hounsfield units. On a CT scan, tension pneumocephalus may present with several characteristic signs. Mount Fuji signs and air bubble signs are among them. "The Mount Fuji sign" refers to the appearance of an air-fluid level inside the sphenoid sinus, which resembles

the silhouette of Japan's iconic Mount Fuji, a symmetrical volcanic mountain. The "air bubble sign" refers to identifying a well-defined air pocket or bubble within the brain parenchyma mainly caused by a tear in the arachnoid membrane. This air pocket can be visualized as a rounded or oval-shaped area of decreased density on CT images, surrounded by brain tissue ^(17, 18). On skull x-ray, tension pneumocephalus may appear as radiolucent (dark) areas within the cranial vault, representing the presence of air. Management of tension pneumocephalus starts with recognizing the symptoms ⁽¹⁹⁾.

Make sure that you stabilize the patient with the ABC approach. Elevate the head of the bed to 30 degrees; administering high-flow oxygen and surgical decompression are very important parts of management. Surgical decompression options include needle aspiration, drilling of burr holes, craniotomy, ventriculostomy, and closure of dural defects. Anesthetic implications in patients with tension pneumocephalus include (a) avoidance of nitrous oxide, as the blood-gas partition coefficient of nitrous oxide is 34 times greater than that of nitrogen, allowing nitrous oxide to diffuse into the cranial vault faster than the nitrogen/air can exit; (b) avoidance of hyperventilation, which can lead to decreased cerebral blood flow causing enlargement of the subdural space potentially entraining additional air; and (c) avoidance of high airway pressures during ventilation, because increased intrathoracic pressure impedes cerebral venous return, further increasing intracranial pressure. Additionally, normobaric hyperoxia with 100% inspired oxygen facilitates faster resolution of pneumocephalus ^(20,21).

4. Conclusions

Tension pneumocephalus is a rare neurosurgical emergency that can occur as a result of trauma

or iatrogenic. Patients with Tension pneumocephalus usually present with severe headaches, altered mental status, seizures, Nausea, and Vomiting. Because of the potential for rapid clinical deterioration and death, prompt brain imaging is warranted to rule out the diagnosis, and urgent neurosurgical consultation is indicated for definitive management.

Conflict of Interest

The authors declare that they have no competing interest

Consent

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the Editor-Chief of this journal.

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Transforming Emergency Care: A Case Study of the University of Gondar Comprehensive Specialized Hospital Emergency Department, under a Resource-limited set up

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ABSTRACT

Background: One of the best practices of ED administration is infrastructure design, system establishment, and uninterrupted ongoing everlasting quality improvement planning. ED senior management must plan, prepare, practice, review, analyze, assess, and strategize for unexpected ED events. UoGCSH is the oldest in Ethiopia and the only referral hospital for more than 13 million people from the five-zone north-west Ethiopia with a 950-bed capacity. During the 2020 G.C., a proposal paper was submitted to the college and hospital administration bodies suggesting stepwise quality improvement of the existing emergency service in terms of infrastructure, ultrastructure and logistics. The proposal suggested short-term, mid-term, and long-term quality improvement segments implemented in an institutionally convenient manner.

Objective: To describe the transformation of emergency and critical care medical services at the University of Gondar Comprehensive Specialized Hospital from scratch to the current status.

Method: A descriptive case study design was applied to narrate critical care service transformation at UoG Comprehensive Specialized Hospital. Since this case study is a data review from gathered secondary data, desk reviews of the emergency department, quality directorate data review, and the annual audit report review, there was no need for IRB approval.

Result and recommendation: After a year of renovation, we were able to organize a newly refurbished emergency room with a triage area with adequate reception space, Red resuscitation area with ten beds (considering patient overflow), Orange with 18 beds, Yellow with 10 beds, and floater area, isolation room, decontamination room, ED laboratory, main store, disaster store and piped oxygen system to all beds. We have gone on a long journey to bring those promised practices into demonstrable practice and, finally, replicable prototypic best practices. Even though we went the extra mile to achieve this status, still we remain behind in reaching the demonstrable tip of the iceberg. Standard emergency room workflow implementation enables us to control the day-to-day patient and attendant crowding that impedes the anticipated medical treatment outcome and results in significant dissatisfaction. Despite this achievement, the establishment of trauma centers and high-quality patient care are recommended.

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Key words: Emergency department, system, best practice, teamwork, University of Gondar

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1. Introduction

The emergency department (ED) is a uniquely unstable environment where someone faces unscheduled and undifferentiated diseased patients, stressed families, unsettled staff, and inequitable resources. It is the day-to-day responsibility of the leaders and managers of the ED to ensure that this thing is delivered with the best care to the patients. One of the best practices of ED administration is ensuring infrastructure design, system establishment, and ongoing everlasting quality improvement planning. ED senior management must plan, prepare, practice, review, analyze, assess, and strategize for unexpected events ⁽¹⁾.

The ED environment is full of interruptions, with multiple interactions and a high density of decision-making. The input, process, and output of ED patients are largely beyond the control of ED staff and managers ⁽¹⁾.

Historical Background of UoGCSH emergency department

UoG-GCMHS

The University of Gondar is one of the oldest and most well-established higher education institutions in the country. It was established in 1954 as a Public Health College and Training Center in a joint effort between the Imperial Ethiopian government, WHO, United States Operation Mission to Ethiopia, and UNICEF, dictated by the pressing health needs that existed in the 1940s and 1950s. It remains Ethiopia's oldest medical training institution. Our college, Gondar College of Medicine and Health Science (GCMHS), is one of the pioneering college faculty under the University of Gondar established in 1954 G.C. Initially, it was established as a Training Center under Addis Ababa University and was later renamed Gondar College of Medical Sciences (GCMS). GCMS

gained autonomy from Addis Ababa University in 1992 G.C.

GCMHS-UoGCSH-Emergency department

University of Gondar Comprehensive Specialized Hospital (UoGCSH) is the only historically old hospital established during the birth of the college enlightenment, and it has been providing tremendous health services to the local community and the wider nation since then. It is located in Gondar city, central Gondar zone, northwest Ethiopia 663 km northwest of Addis Ababa. UoGCSH is the oldest in Ethiopia and the only referral hospital for more than 13 million people. It serves more than 950 beds capacity. It has a feeder catchment area of 3 general hospitals, 15 primary hospitals, 14 government health centers, and other private health sectors in the city.

The emergency department under UoGCSH was not established independently until recently when grassroots paradigm changes occurred. It was initially led mainly by the giant Department of Internal Medicine and the Department of General Surgery for which there was no known responsible body to handle the distinct leadership of the field. Due to this unrecognized diffusion of responsibilities, the health service delivered to the community was not as similar to that of other parts of the nation and the world. Because of this historical retardation, a team of physicians took the initiative to propose the change of this historical defect aiming for a well-organized, well-structured, well-equipped, and well-maintained emergency system that is independent of its historical joint venture.

During the 2020 G.C., a proposal paper was submitted to the college and hospital administration bodies suggesting stepwise quality improvement of the existing emergency service in terms of infrastructure and logistics. The proposal suggested short-term, mid-term, and long-term

quality improvement segments. The short-term goals aimed at renovating the existing infrastructure and health service system to cope with and catch up with the ever-growing and everlasting emergency health service demand. The mid-term goals were to have another revitalized new building and be an independently recognized academic segment of the school of the college teaching communities, thereby enabling the launching of residency as part of the quality health service reassurance arena. The third and long-term proposed plan was to have an isolated, well-functioning medical and trauma center that aligns with the international WHO standard.

Objective

To describe the transformation of emergency and critical care medical services at the University of Gondar Comprehensive Specialized Hospital from scratch to the current status.

2. Methods

A descriptive case study design was used to narrate emergency and critical care service transformation at UoG Comprehensive Specialized Hospital. Data was gathered from desk reviews of the emergency department, quality directorate, and the annual audit report. Since this study is a data review from gathered secondary data, desk reviews of the emergency department, quality directorate data review, and the annual audit report review, there was no need for IRB approval.

2.1 Baseline Assessment to see the extent of service delivery and outcome

The aim of the baseline assessment of Gondar University Specialized Hospital adult emergency room service was to know the real emergent patient overload, patient length of stay, patient mortality, and resource accommodation, thereby expanding and improving emergency

medical services for those who need emergency medical treatment for all trauma critical illness. These would aid in improving patient survival and health outcomes whatever the case scenario be it medical emergencies or traumatic injuries. This assessment was also aimed at spreading best practices to similar areas as a role model and being a pioneer in medical emergency care system expansion regionally and nationally.

University of Gondar Comprehensive Specialized Hospital has been delivering health services for over half a century since its establishment. Among these, emergency medical service was one of the main roles that it was playing. Before the era of the Ethiopian millennium, this in-hospital emergency medical service was not given an emphasis and priority to the demanding population. The service was given in a small 8-by-12-meter area, combining all unsorted cases and severity except pediatric, obstetrics, and gynecology emergency cases. This service continued with this confined space until 2015 G.C., when the space was expanded and restructured according to the WHO and EHSTG recommendation into Red, Orange, and green and other service areas like ED laboratories, pharmacy, and ED procedure room. Red had 3 beds, Orange had 24 beds, and Green had 14 beds. Despite this limited number of beds, the emergency room always had a flooding turnover of patients, irrespective of the case and severity. The annual flow of patients to the emergency department was approximately 23,400, and more than 400,000 clients were sent to the hospital ⁽²⁾.

By 2016/17G.C., there were no emergency medicine and critical care physicians, but 3 critical care nurses were managing critical patients. There was also a shortage of supplies, like basic equipment for patient resuscitation, and almost no emergency drugs, both in the pharmacy,

emergency unit, and ICU, creating another obstacle in providing quality care.

This baseline assessment showed vivid gaps that were present for years in history. Exemplary figures and images are illustrated below to mention some.

Among the national emergency service expansion strategy measurement tools of key performance indicators, ED patient triage time, ED mortality, and ED patient length of stay are the ones that are measured against the stated target. Our patient triage within five minutes ranged from 60-70%. Our ED mortality ranged from 3-4%. Our patient length of stay of more than 24 hours transformed from more than 50% to less than 10%. *(See supplementary figures for previous setups figure 1, 2, and 3)*

2.2 Admin engagement

The Federal Ministry of Health was well committed to expanding emergency and critical care services by designing a national strategy to implement these services across the country ⁽³⁾.

As part of the hospital's five-year strategic plan, the hospital administration team was kin to support the new proposal idea for exploring internal and external support in terms of technical support, funds, logistics, and human resource capacity building.

2.3 Conflict resolution

The departments that were engaged in the history of the emergency room were also the pioneers in initiating the human resource development required for the launching of quality improvement. There was no known raised conflict of interest among the mentioned and other service areas regarding the leadership of the emergency room.

5. Result

3.1 infrastructure/physical space

The Existing emergency room had optimally unused space which if appropriately restructured could be used for the short-term clinical emergency service. The structure and proximity of the building make it easily accessible and possible to link with the main lab, OR, surgical ICU, and radiology unit. After repeated discussions of the issue with the administration body, the admin was able to find an external funder and arrange a framework of agreement for the implementation of the project. After a year of renovation, we were able to organize a newly refurbished emergency room with a triage area with adequate reception space, Red resuscitation area with 10 beds (considering patient overflow), Orange with 18 beds, Yellow with 10 beds, and a floater area, isolation room, decontamination room, ED laboratory, main store, disaster store and piped oxygen system to all beds. *(see supplementary material for figures 4, 5, 6, 7, 8, and 9)*

3.2 ultra-structure /system

3.2.1 Standard operations, protocols, and clinical decisions

We were able to articulate new standard operating procedures and protocols for the clinical staff, and also, we were able to design new patient flow system in collaboration with the respective departments and service areas. The scope of practice and leadership responsibility finally resides in the hands of the drivers with a smooth transition of power.

3.2.2 Logistics and Supplies

We were able to collect the necessary materials, instruments, and other logistics required for the refurbishment of the ED from the hospital and the external funder. We collect 40+ beds (6 are multipurpose resuscitation beds), 3 crash carts,

4 suction machines, 10 patient monitor machines, 4 perfusers, 3 mechanical ventilators, and other resources required as per standard. (see supplementary figure 9)

3.3 Patient

We were able to manage patients through the newly established infrastructure and ultrastructure changing the previous customs of treating patients with no designated case sensitive, case severity manner. We were able to control and maintain the ED surge capacity through the day-to-day active decision-making culture. Patients are no longer treated on floors, corridors, and reception areas. We hope through this new culture, we have introduced proper patient management, patient and family satisfaction, and staff satisfaction despite the ongoing resource limitations in the setup.

3.4 Performance indicators

Among the national emergency service expansion strategy measurement tools of key performance indicators, ED patient triage time, ED mortality, and ED patient length of stay are the ones that are measured against the stated target. Our patient triage within five minutes was transformed from 60-70% to 100 % performance. Our ED mortality dramatically transformed from 3-4% to 1.2-2.1%, a significant decrease from the baseline and approaches to the national target (< 0.5%) requiring ongoing gap identification and quality improvement. Our patient length of stay of more than 24 hours transformed from more than 50% to less than 10%. The above statistical numbers were consistently trending proved by monthly clinical audits and annual audit reports. We strive to achieve more quality improvement indicators per the recommendation of the national Ethiopian health sector transformation guideline ⁽⁴⁾.

3.5 Leadership and Management

Now, the leadership and management are being run by the newly established department and fellow emergency and critical care medicine physicians. We have been through this for the last one and a half years and we have seen significant trending changes.

3.6 Human capacity development

3.6.1 Staff training

Despite being in the warzone, war region, and broken economy, we were able to give training for both integrated emergency medicine case management and ICU patient care. (See supplementary materials for evidence in Figures 10 and 11)

3.6.2 Residency training

As part of the continuous sustainable reassurance of quality health service, excellence in the academic arena is a very important journey and framework for quality improvement. Regarding this program, we were able to launch a postgraduate residency program on emergency and critical care medicine last year 2023 G.C. fulfilling all the requirements and materials. Now, we have second- and first-year postgraduate students helping the system to run well calibrated. (See supplementary figures for evidence in figures 12 and 13)

6. Discussion and Conclusion

Olivier Serrat articulates good practice as anything that has been tried and shown to work in some way—whether fully or in part but with at least some evidence of effectiveness—and that may have implications for practice at any level elsewhere. Good practice is a process or methodology that is effective in one part of the organization and might be effective in another, too.

We have gone on a long journey in bringing those promised practices into demonstrable practice and finally replicable prototypic best practices.

Even though we went the extra mile to achieve this status, we remain behind in reaching out to the demonstrable tip of the iceberg. Standard emergency room workflow implementation enables us to control the day-to-day patient and attendant crowding that impedes the anticipated medical treatment outcome and results in significant dissatisfaction. We hope that this groundbreaking clinical practice will lead to a further boost in health quality improvement and sustainable service delivery in the hospital, region, and the nation as well.

We, the emergency department members, are always optimistic about the introduction of new system designs and applicable changes that will positively affect the staff and the user community.

3. Limitations and recommendations

For comprehensive well-functioning emergency setups, there are always stakeholders that interlink and interplay with one another for mutual collaboration. Every department and unit has roles and responsibilities to make sure that the input process output principle is always effectively implemented. For this to be sustainable, the communication system and platforms shall always be updated and upgraded. For now, we are giving undifferentiated medical services for both trauma and non-trauma adult patients due to a lack of space, logistics, and human resources, but in the future, it has to be separated to give standard treatment as per WHO recommendations. Since the vicinity is a trauma-prone area, there has to be a separate trauma center complex.

Our limitations are enumerable under this resource-limited setup compared to what we could perform if we had been provided infrastructure, logistics, human resources, and technical support. The combined medical service affected our

patient outcomes for both trauma and medical cases. The crippled referral system both from catchment government health sectors and private centers greatly affected our clinical practice. We were not able to fully launch the prehospital medical service as expected due to the ongoing conflict. The ongoing conflict in the region also affected our academic and clinical practice to the great extent that we could not create links with international best setups to share experiences and other supports.

Futurities

We aspire to a bright future in the newly emerging department despite the limitations and threats. We have plenty of opportunities to explore, plan, design, and perform in the clinical service arena. We are also hopeful that the scratched quality improvement process will be continued and sustained by the hospital admins, the university, and external collaborators.

Conflict of Interest

No competing interest

Consent

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the Editor-Chief of this journal.

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Nursing Science Trend, Current and Challenges in Ethiopia: A Narrative Review Evidence from Recent Literature and Policies

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ABSTRACT

Background: Nursing is a profession dedicated to promoting and maintaining the health and well-being of individuals, families, and communities. In recent years, the nursing profession has undergone significant changes in Ethiopia, with the number of nurses increasing and the profession becoming more professionalized. However, there are still significant challenges facing the nursing profession in Ethiopia, such as the shortage of nurses, poor working conditions, and lack of education and training.

Objective: To explore the current trends, advancements, and challenges within the field of nursing science in Ethiopia, drawing evidence from recent literature and policies.

Methods: A rapid narrative review was carried out utilizing PubMed/MEDLINE, Web of Science, and EMBASE to identify full-text original research articles written in English. Specific search criteria were applied to ensure the inclusion of relevant studies while establishing exclusion criteria to guide the selection process.

Conclusion and recommendation: The nursing profession in Ethiopia faces several challenges. The government and the nursing community need to work together to address these challenges and ensure that Ethiopia has a sufficient number of well-trained nurses to meet the needs of its population.

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1. Introduction

Nursing is a profession dedicated to promoting and maintaining the health and well-being of individuals, families, and communities. It encompasses a wide range of roles and responsibilities, including providing direct patient care, advocating for patients' rights, and collaborating with interdisciplinary teams to achieve optimal healthcare outcomes⁽¹⁾. Nursing is essential in healthcare systems worldwide, serving as the backbone of patient care. Nurses are at the forefront of healthcare delivery, providing holistic, patient-centered care across various healthcare settings. They play a vital role in disease prevention, health promotion, and managing acute and chronic conditions⁽²⁾.

Over time, nursing practice has evolved and expanded to meet the changing needs of populations and advancements in healthcare. Nurses now engage in evidence-based practice, integrating research findings into their clinical decision-making to deliver high-quality care⁽³⁾. They also embrace technological advancements, such as electronic health records and telehealth, to enhance communication and improve patient outcomes⁽⁴⁾.

Nursing education equips individuals with the knowledge and skills required to provide safe and effective care. It includes both academic and practical training, leading to various levels of nursing degrees, such as diplomas, bachelor's degrees, and advanced practice degrees^(5,6).

2. Methods

Searching Strategy: To identify all studies that investigated nursing science, a search of the electronic database containing keywords such as "nursing science," "trend," "current," and "Challenge" was conducted. The search engines PubMed, Google Scholar, and EMBASE were used to

identify peer-reviewed English language literature. In addition, the reference lists from relevant studies were examined to identify older papers and unpublished literature in particular.

3. Results

Nursing Trend in Ethiopia

The nursing profession in Ethiopia has undergone significant changes in recent years. Nursing was seen as a low-status profession in the past, but this is now changing⁽⁷⁾. As a result, the number of nurses in Ethiopia is increasing, and the profession is becoming more professionalized. The number of nurses in the country has increased significantly. This growth has been driven by several factors, including the increasing demand for healthcare services, the government's investment in nursing education and training, and the efforts of the Ethiopian Nurses Association to promote the profession.

One of Ethiopia's most significant nursing trends is the increasing number of nurses with bachelor's degrees. In the past, most nurses only had diplomas or certificates, but now there is a growing emphasis on baccalaureate-level education. This is in line with global trends and is seen as essential for improving the quality of nursing care⁽⁸⁾.

According to the World Bank, Ethiopia's nurse to population ratio was 0.7844 in 2020. This means there were 0.78 nurses and midwives for every 1,000 people in Ethiopia. In 2010, the nurse to population ratio was 0.57, so the number of nurses has increased by 37% over the past ten years⁽⁹⁾. Another trend is the increasing specialization of nurses. In the past, nurses typically worked in general hospitals, but now, there is a growing demand for nurses with specialized skills in areas such as critical care, pediatrics, and public health. This is due to the population's changing needs and the increasing complexity of healthcare.

Current status of nursing in Ethiopia

Despite the progress that has been made, there are still significant challenges facing the nursing profession in Ethiopia. One of the biggest challenges is the shortage of nurses. The nurse-to-patient ratio in the country is estimated to be around 1:12, which is much higher than the recommended ratio of 1:6^(7,9). This shortage is particularly acute in rural areas, where many health facilities are understaffed. The World Health Organization (WHO) estimates that Ethiopia needs an additional 100,000 nurses to meet the needs of its population⁽¹⁰⁾. This shortage is due to several factors, including the high demand for nurses, the low salaries offered to nurses, and the lack of opportunities for professional development^(11,12).

Another challenge facing the nursing profession in Ethiopia is the poor working conditions for nurses. Nurses often work long hours, with little time for breaks or rest. This can lead to burnout and stress, impacting the quality of care that nurses provide⁽¹³⁾.

Challenges of nursing in Ethiopia

The challenges facing the nursing profession in Ethiopia are complex and interrelated⁽¹²⁾. This shortage is due to a number of factors, including the high demand for nurses, the low salaries offered to nurses, and the lack of opportunities for professional development^(14,15). Nurses in Ethiopia often work long hours, with little time for breaks or rest. This can lead to burnout and stress, which can impact the quality of care that nurses are able to provide. Many nurses in Ethiopia do not have the necessary education and training to provide quality healthcare. This is because there are not enough nursing schools in the country, and the quality of education at these schools is often poor⁽¹⁶⁾.

4. Discussion

The evolution of the nursing profession in Ethiopia reflects significant progress and ongoing challenges. Recent developments, such as the increase in the number of nurses with bachelor's degrees and growing specialization within the field, indicate a positive shift toward enhancing the quality of care and meeting the diverse needs of the population. The trend towards higher educational qualifications aligns with global movements aimed at improving nursing standards and ensuring evidence-based practice⁽⁸⁾. This educational advancement is crucial, as it supports the delivery of more comprehensive and effective patient care, fostering a more skilled and knowledgeable nursing workforce.

However, despite these advancements, the nursing profession in Ethiopia continues to face substantial challenges. The shortage of nurses remains a critical issue, with the current nurse-to-patient ratio estimated at 1:12, significantly higher than the recommended ratio of 1:6^(7,9). This shortage is exacerbated by factors such as low salaries, high demand for services, and inadequate professional development opportunities^(11,12). The World Health Organization's estimate that Ethiopia requires an additional 100,000 nurses underscores the severity of this issue and highlights the need for targeted interventions to address workforce gaps⁽¹⁰⁾.

Furthermore, the working conditions for nurses in Ethiopia contribute to the problem. Long hours, insufficient breaks, and high stress levels are common, leading to burnout and negatively impacting the quality of care⁽¹³⁾. These working conditions not only affect nurses' well-being but also compromise patient outcomes, underscoring the need for improvements in work environments and support systems for healthcare professionals.

Additionally, the quality of nursing education remains a concern. Despite the increase in baccalaureate-prepared nurses, the overall quality of nursing education and training is often compromised by limited resources and substandard educational facilities⁽¹⁶⁾. Addressing these educational deficits is vital for ensuring that nurses are adequately prepared to meet the demands of modern healthcare.

The complexity of the challenges facing the nursing profession in Ethiopia requires a multifaceted approach. Solutions must include increasing investments in nursing education, improving working conditions, and addressing salary disparities. Collaborative efforts between the government, healthcare institutions, and the nursing community are essential to develop and implement effective strategies that will enhance the capacity and capabilities of the nursing workforce.

Strengths and Limitations of the Study

This study presents several strengths. Firstly, it utilized a comprehensive search strategy across multiple electronic databases, including PubMed, Google Scholar, and EMBASE, and reviewed reference lists from relevant studies. Additionally, the focus on nursing in Ethiopia provides a detailed and context-specific analysis, offering valuable insights into the country's unique healthcare challenges and trends. Furthermore, the identification of significant trends, such as the increase in baccalaureate-prepared nurses and growing specialization, alongside critical challenges like nurse shortages and poor working conditions, contributes to a well-rounded understanding of the field.

However, the study also has limitations. By focusing exclusively on peer-reviewed English-language literature, it may have excluded relevant research published in other languages or grey literature, potentially leading to publication bias

and an incomplete representation of available evidence. The variability in data sources and the specific focus on Ethiopia may limit the generalizability of the findings to other contexts with different healthcare systems and nursing practices. Additionally, while the study highlights the increase in nurses with bachelor's degrees, it does not deeply explore the quality of nursing education and training programs. Further investigation into educational standards and their impact on practice would offer a more comprehensive view. Lastly, the study addresses significant challenges but may not fully encompass all complexities, such as policy implementation issues, regional disparities, and specific barriers to professional development.

5. Conclusion and recommendation

The nursing profession in Ethiopia is facing several challenges. However, there are also several promising trends, such as the increasing number of nurses with bachelor's degrees and the growing specialization of nurses. If these trends continue, the nursing profession in Ethiopia will be well-positioned to meet the needs of the country's growing population. The government and the nursing community need to work together to address these challenges and ensure that Ethiopia has a sufficient number of well-trained nurses to meet the needs of its population.

Abbreviation

WHO: World health organization

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