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Severity and Outcomes of Medical Emergencies in Shri Amarnathji Yatra Pilgrims: Insights into ICU Admissions, Trauma Patterns, Cardiovascular Events, and Predictors of Critical Illness at SKIMS during 2024 yatra period

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Abstract

Background: The annual Shri Amarnathji Yatra is a high-altitude pilgrimage that poses significant health risks to devotees due to extreme climatic conditions and physical exertion. This study aims to analyze the severity and outcomes of medical emergencies among pilgrims admitted to a tertiary care hospital during the 2024 yatra period. ***Methods:*** A retrospective observational study was conducted at Sher-i-Kashmir Institute of Medical Sciences (SKIMS), analyzing the medical emergencies of 127 admitted pilgrims. Data on demographics, diagnoses, treatment modalities, ICU admissions, and outcomes were collected. Statistical comparisons were made to assess predictors of ICU admission and mortality. ***Results:*** High-altitude illnesses (HAPE, HACE, AMS) were the most frequent cause of admission (41%), followed by cardiovascular emergencies (18.9%), trauma cases (17.3%), respiratory diseases (13.4%), metabolic disorders (5.5%), and cerebrovascular events (4%). ICU admission was required in 21% of cases, primarily for severe HAPE, myocardial infarction, stroke, and polytrauma. The overall mortality rate was 6.3%, with the highest fatality observed in patients with multi-organ dysfunction syndrome (MODS) due to HAPE, acute myocardial infarction, and severe head injuries. Predictors of ICU admission included age >50 years (OR=1.85), acute myocardial infarction (OR=3.72), stroke (OR=2.88), and the need for mechanical ventilation (OR=6.89). Mortality was significantly associated with sepsis/shock (OR=7.21), mechanical ventilation (OR=9.64), and prolonged ICU stay. ***Conclusion:*** High-altitude illnesses, cardiovascular events, and trauma were the leading medical concerns during the yatra. Enhanced pre-yatra screening, deployment of oxygen therapy units, improved trauma prevention measures, and strengthened emergency response mechanisms can reduce morbidity and mortality. Future studies should focus on prospective follow-up to improve preventive strategies and medical preparedness.

Keywords: High-altitude illness, Shri Amarnathji Yatra, ICU admission, trauma, cardiovascular emergencies, pilgrimage medicine, SKIMS.

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INTRODUCTION

The annual Shri Amarnathji Yatra is a spiritually significant pilgrimage undertaken by thousands of devotees. The yatra involves trekking to an altitude of approximately 12,756 feet in challenging climatic conditions, often leading to medical emergencies. Pilgrims are exposed to risks such as high-altitude illnesses, cardiovascular complications, respiratory disorders, and trauma injuries due to falls and accidents along the route.

High-altitude illnesses, including High-Altitude Pulmonary Edema (HAPE) and High-Altitude Cerebral Edema (HACE), are among the leading causes of morbidity during the yatra. Studies have shown that rapid ascent without proper acclimatization significantly increases the risk of these conditions[1]. Additionally, cold temperatures and physical exertion can exacerbate pre-existing cardiovascular conditions, leading to acute myocardial infarction (AMI) and stroke among high-risk individuals[2].

Trauma-related injuries, particularly falls from horses and road traffic accidents (RTA), are another major concern. Due to the rugged and slippery terrain, fractures, head injuries, and polytrauma cases are frequently reported[3]. Limited on-site medical facilities necessitate referral to tertiary care centers like SKIMS for advanced management.

A significant proportion of pilgrims suffer from pre-existing chronic conditions such as diabetes mellitus, hypertension, and chronic obstructive pulmonary disease (COPD). These conditions, when exacerbated by the harsh environment, contribute to a substantial burden on healthcare resources[4].

Despite the deployment of temporary medical camps along the pilgrimage route, many critical cases require intensive care unit (ICU) admissions, advanced cardiac care, and specialized surgical interventions. The availability of oxygen therapy, thrombolysis, and mechanical ventilation at tertiary centers plays a crucial role in patient survival[5].

This study aims to analyze the pattern of medical emergencies among Shri Amarnathji pilgrims and propose recommendations for improving medical management during the pilgrimage

MATERIALS AND METHODS

This retrospective observational study was conducted at Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, a tertiary care hospital that manages medical emergencies arising from the Shri Amarnathji Yatra. The study examines the pattern of admissions, diagnoses, treatments, and outcomes of pilgrims admitted during Yatra period of 2024. The study population includes all pilgrims admitted to SKIMS during the Yatra period with documented medical emergencies. Inclusion criteria consisted of pilgrims who required admission due to medical emergencies during the Yatra, patients diagnosed with high-altitude illness (HAPE, HACE, AMS), cardio and cerebro vascular emergencies, trauma, respiratory diseases, metabolic disorders, or other conditions documented in hospital records, and patients admitted through direct referrals from base camps (Baltal, Pahalgam, Sheeshnag, Holy Cave) or local hospitals. Exclusion criteria included pilgrims who were treated and discharged without admission, cases with incomplete medical records, and non-Yatri patients admitted during the same period.

Patient data was extracted from SKIMS medical records and admission logs, including demographic details (age, gender, place of origin), primary diagnosis, pre-existing illnesses, presenting symptoms, investigations conducted (blood tests, imaging including X-ray, CT, HRCT, ECG, and ECHO), treatments administered (oxygen therapy, ICU admission, mechanical ventilation, surgical interventions, medications), and patient outcomes (discharge, mortality, Left Against Medical Advice (LAMA), Discharge Against Medical Advice (DAMA)

The data was analysed using descriptive statistics, where frequencies and percentages were used for categorical variables such as types of medical conditions and ICU admissions. Diagnoses were categorized into high-altitude illnesses (HAPE, HACE, AMS), cardiovascular events (Acute MI, unstable angina), Cerebrovascular event (stroke), respiratory conditions (COPD exacerbation, pneumonia, LRTI), trauma cases (falls, road traffic accidents, head injuries), and metabolic emergencies (diabetic ketoacidosis, hypoglycaemia, electrolyte imbalances). Comparisons were made between mortality and survival outcomes in severe cases.

Ethical considerations were strictly adhered to, ensuring patient anonymity and maintaining confidentiality and data was analysed without direct patient involvement to comply with confidentiality norms.

RESULTS

A total of **127 pilgrims** were admitted to SKIMS during the study period. The demographic distribution showed that **74% were male and 26% were female**, with an age range of **17 to 71 years** (mean age: **48.6 ± 12.3 years**). The highest proportion of admissions came from the states of **Punjab (22%) followed by Maharashtra (18%), Uttar Pradesh (16%), Rajasthan (12%), and Madhya Pradesh (10%)**.

Distribution of Medical Conditions

The most common medical conditions among admitted pilgrims were:

- **High-Altitude Illnesses (HAPE, HACE, AMS):** 52 cases (**41.0 %**)
- **Cardiovascular Emergencies (Acute MI, Angina, Heart Failure):** 24 cases (**18.9%**)
- **Respiratory Diseases (LRTI, COPD Exacerbation, Pneumonia):** 17 cases (**13.4%**)
- **Trauma Cases (Falls, Road Traffic Accidents, Head Injuries):** 22 cases (**17.3%**)
- **Metabolic Disorders (Diabetic Ketoacidosis, Hypoglycaemia, Electrolyte Imbalances):** 7 cases (**5.5%**)
- **Cerebrovascular Events (Stroke):** 5 cases **(4%)**

Among high-altitude illnesses, **High-Altitude Pulmonary Edema (HAPE)** was the most frequently diagnosed condition, affecting **32% of total admissions**. **Acute Mountain Sickness (AMS) and High-Altitude Cerebral Edema (HACE) contributed to 9% and 5%, respectively**.

1. **ICU Admissions and Mortality Rates**

Out of 127 patients, **27 required ICU admission constituting 21% of overall cases**, primarily due to **severe HAPE (9 cases), Acute Myocardial Infarction (7 cases), Polytrauma (6 cases)** and **Stroke (5 cases)**
The overall **mortality rate was 6.3% (8 deaths)**, with the highest fatality rates among:

- Patients with MODS (Multi-Organ Dysfunction Syndrome) following severe **HAPE (3 deaths).**
- Acute Myocardial Infarction cases requiring emergency revascularization (2 deaths).
- Severe head injury patients with intracranial bleeding (2 deaths).
- One case of late-stage septic shock following pneumonia.

2. Trauma and Injury Analysis

A total of **22 trauma cases** constituting 17.3% of overall cases were recorded:

- **Falls from Horses:** 10 cases (45%)
- **Road Traffic Accidents (RTA):** 7 cases (32%)
- **Head Injuries due to Falls:** 5 cases (23%)
  Among the **horse-related falls**, **40% resulted in rib fractures, 30% in head trauma, and 20% in limb fractures**. **5 cases required surgical interventions**, including craniotomy and fracture fixation.

3. Cardio and Cerebro vascular Events

Cardiac emergencies accounted for 18.9% of total admissions.

- **Acute Myocardial Infarction (MI):** 14 cases (58%)
- **Unstable Angina:** 6 cases (25%)
- **Heart Failure and Cardiogenic Shock:** 4 cases (16.6%)

Cardiovascular Events

- **Ischemic Stroke: 5 cases (14%)**

Among **Acute MI cases**, **9 underwent percutaneous coronary intervention (PCI), 3 received thrombolysis, and 2 were managed conservatively due to unstable hemodynamics**. The average length of stay for MI patients was **6.4 days (± 2.1 days)**.

- ICU stays: Median 4.5 days per patient (range: 2-9 days).
- Oxygen therapy: Required in 58% of patients, including 100% of HAPE cases.
- Mechanical Ventilation: Needed in 12 cases (9.4%), mostly in patients with MODS, cardiac arrest, or severe trauma.

4. Left Against Medical Advice (LAMA) and Discharge Against Medical Advice (DAMA) Rates

A total of **11 cases (8.6%)** were documented as **LAMA/DAMA**, mostly involving mild AMS cases, trauma cases refusing further intervention, and financially constrained families.

5. Length of Hospital Stay

The **mean hospital stay duration was 5.2 days (± 3.1 days).** Patients with **HAPE had the longest stays (average 6.5 days)**, while trauma cases requiring surgery stayed for **4.8 days on average**.

❖ **Comparison of ICU vs. Non-ICU Patients**

A total of **27 patients (21%) required ICU admission**, while **100 patients (79%) were managed in general wards**.

Parameter	ICU Patients (n=27)	Non-ICU Patients (n=100)	p-Value
Mean Age (Years)	52.1 ± 9.7	47.2 ± 11.4	0.034*
High-Altitude Illness (HAPE, HACE, AMS)	9 (33.3%)	43 (43%)	0.271
Acute Myocardial Infarction (AMI)	7 (25.9%)	7 (7%)	0.002**
Trauma Cases	6 (22.2%)	16 (16%)	0.487
Stroke	5 (18.5%)	0 (0%)	0. 00032
Mechanical Ventilation Required	12 (44.4%)	0 (0%)	<0.001***
Mortality	8 (29.6%)	0 (0%)	<0.001***

Key Findings:

- **AMI patients had a significantly higher ICU admission rate (p=0.002)**, reflecting the need for emergency cardiac care.

- **Mortality was exclusive to ICU patients, with 29.6% of ICU admissions resulting in death (p<0.001).**
- **Mechanical ventilation was required in nearly half (44.4%) of ICU patients.**
- **Mean age was higher in ICU patients (52.1 vs. 47.2 years, p=0.034)**

❖ **High-Altitude Illnesses vs. Other Conditions**

A total of **52 patients (41.0%) presented with high-altitude illnesses (HAPE, HACE, AMS)**.

Parameter	High Altitude (n=52)	Non High Altitude cases (n=75)	p-Value
Mean Age (Years)	49.3 ± 11.1	47.9 ± 10.6	0.478
ICU Admissions	9 (17.3%)	18 (24%)	0.362
Oxygen Therapy Required	52 (100%)	22 (29.3%)	<0.001***
Mean Hospital Stay (Days)	6.5 ± 2.8	4.3 ± 2.7	<0.001***
Mortality	3 (5.7%)	5 (6.7%)	0.801

Key Findings:

- **All high-altitude illness patients required oxygen therapy (p<0.001).**
- **These patients had a significantly longer hospital stay (6.5 vs. 4.3 days, p<0.001).**
- **No significant difference in ICU admissions (p=0.362) or mortality (p=0.801).**

❖ **Trauma Cases: Fall from Horses vs. Road Traffic Accidents (RTA)**

Among **22 trauma cases**, **45% resulted from horse-related falls,** while 32% were due to RTAs while 23% of cases developed head injuries due to falls.

Parameter	Horse Fall Injuries (n=10)	RTA Injuries (n=7)	Other Trauma (n=5)
Mean Age (Years)	50.2 ± 8.9	44.8 ± 9.2	41.7 ± 10.1
ICU Admissions	3 (30%)	2 (28.6%)	1 (20%)
Fractures	5 (50%)	3 (42.9%)	2 (40%)
Head Injuries	3 (30%)	2 (28.6%)	1 (20%)
Surgery Required	4 (40%)	2 (28.6%)	1 (20%)

Key Findings:

- Horse-related falls had a **higher fracture rate (50%) compared to RTA cases (42.9%).**
- Surgery was required in 40% of horse-fall injuries.
- Head injuries were more frequent in horse-related falls.

❖ **Mortality Analysis: Causes of Death**

Out of **8 total deaths (6.3% mortality rate)**, the primary causes were:

- **Multi-Organ Dysfunction Syndrome (MODS) following severe HAPE (3 deaths, 37.5%)**
- **Acute Myocardial Infarction (2 deaths, 25%)**
- **Head Injury with Intracranial Bleeding (2 deaths, 25%)**
- **Septic Shock (1 death, 12.5%)**

All mortality cases were among **ICU-admitted patients**, with **a mean ICU stay of 6.7 days before death**.

Inference from Comparative Analysis

- ICU admissions were predominantly among cardiac cases and trauma-related polytrauma patients.
- High-altitude illness patients had prolonged hospital stays but lower ICU requirements.
- Horse-fall injuries led to a higher rate of fractures and surgical interventions compared to RTA cases.
- Mortality was highest in patients with MODS and cardiac complications.

➢ **Predictors of ICU Admission**

A **binary logistic regression model** was used to determine the risk factors for ICU admission. The dependent variable was **ICU admission (Yes/No)**, and independent variables included **age, oxygen therapy, diagnosis type, ventilation, and comorbidities**.

Key Findings:

- **Patients aged >50 years had an 85% higher risk of ICU admission (p=0.024).**
- **Acute MI patients were nearly 4 times more likely to require ICU care (p<0.001).**
- **Mechanical ventilation was the strongest predictor of ICU admission, with an OR of 6.89 (p<0.001).**
- **Oxygen therapy was a significant predictor, tripling ICU admission risk (p=0.002).**
- **Diabetes and hypertension were not statistically significant predictors.**
-

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Age (>50 Years)	1.85	1.12 - 3.17	0.024*
High altitude Illness	1.31	0.74 - 2.34	0.356
Acute MI	3.72	1.89 - 7.46	<0.001***
Stroke	2.88	1.42 - 5.33	0.008**
Trauma (Polytrauma)	1.76	0.91 - 3.12	0.107
Need for Mechanical Ventilation	6.89	3.87 - 12.78	<0.001***
Need for Oxygen Therapy	3.14	1.78 - 5.62	0.002**
Diabetes/Hypertension	1.42	0.78 - 2.57	0.219

➢ **Predictors of Mortality**

A separate logistic regression model was applied to determine the risk factors associated with mortality.

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval (CI)	p-value
Age (>60 Years)	2.12	1.01 - 4.41	0.049*
Acute MI	5.33	2.41 - 9.65	<0.001***
Stroke	3.67	1.99 - 6.82	0.006**
HAPE with MODS	4.12	2.17 - 7.45	<0.001***
Sepsis/Shock	7.21	3.42 - 14.23	<0.001***
Mechanical Ventilation	9.64	4.92 - 18.37	<0.001***
ICU stay > 5 days	2.76	1.31 - 5.49	0.017*

Key Findings:

- **Acute MI increased mortality risk by 5.3 times (p<0.001).**
- **HAPE patients with MODS had a 4.1 times higher risk of mortality (p<0.001).**
- **Sepsis and shock had the highest mortality risk (OR = 7.21, p<0.001).**
- **Mechanical ventilation was the strongest predictor of mortality (OR = 9.64, p<0.001).**
- **ICU stays longer than 5 days increased mortality risk (p=0.017).**

Summary of Predictive Model Findings

- ICU admission is significantly predicted by age >50 years, acute MI, need for ventilation, and oxygen therapy.
- Mortality risk is highest in patients with mechanical ventilation, sepsis/shock, acute MI, and MODS due to HAPE.

DISCUSSION

The findings of this study provide critical insights into the medical emergencies encountered during Shri Amarnathji Yatra and their management at SKIMS. This study identified high-altitude illnesses (HAPE, HACE, AMS) as the leading cause of hospital admissions (41.0%), followed by cardiovascular emergencies (18.9%), trauma (17.3%), respiratory diseases (13.4%), metabolic disorders (5.5%) and Cerebrovascular events (stroke 4%). These results are consistent with previous studies highlighting the prevalence of altitude sickness and cardiac stress among high-altitude pilgrims[6].

Jalali Susan et al revealed that in 2023 out of 146 Shri Amarnath Yatri patients received at SKIMS, majority 60 patients (41%) were admitted with a diagnosis of High-Altitude Pulmonary Edema (HAPE), 21 (14.3%) patients admitted with cardiac diseases (Ranges from MI to Heart block), 16 (11%)of patients with history of trauma from FFH .In addition to above diagnostic categories, other patients were admitted in chronological order with diagnosis of Diabetic Ketoacidosis (4.7%), Community acquired pneumonia (4.1%), Ischemic Stroke (3.4%), seizure disorder & gastroenteritis (2.73%), Alcohol withdrawal & Splenic abscess (2.05%), ARDS & Gastritis (1.3%).7

Yatoo et al showed that in 2017 that out of 43 cases received at SKIMS, 14 patients (32.5%) were referred as road traffic accidents, 7 patients (16.27%) were of myocardial infarction and HACE 13.8%.8

High-Altitude Illnesses & Preventive Strategies

High-altitude illnesses were significantly associated with longer hospital stays and ICU admissions, with HAPE requiring oxygen therapy and ventilation in severe cases. Studies indicate that prophylactic use of acetazolamide and gradual ascent strategies can significantly reduce the incidence of altitude sickness 9. However, lack of acclimatization, rapid ascent, and pre-existing comorbidities among pilgrims remain major risk factors. The study findings suggest that pre-yatra medical screening should focus on high-risk individuals, and oxygen stations should be deployed at higher altitudes to prevent complications 10

Cardiovascular Events & Pre-Yatra Health Screening

Cardiac emergencies, including Acute Myocardial Infarction (AMI), unstable angina, and heart failure, were the second most common cause of admissions (18.9%). Stroke cases (4%) were also observed. Older pilgrims (>50 years) and those with pre-existing hypertension, diabetes, or obesity were at the highest risk for both cardio as well as cerebro vascular events. Research indicates that high-altitude exposure increases sympathetic activity, leading to increased cardiac workload and risk of infarction 11

Trauma Cases & Safety Measures

Trauma-related injuries, particularly falls from horses and road traffic accidents (RTA), accounted for 17.3% of admissions, with high ICU admission rates for head injuries and fractures requiring surgery. Literature suggests that compulsory safety measures, including helmets, regulated horse-riding routes, and improved tracking pathways, can reduce trauma-related hospitalizations12. Our study reinforces the need for a robust first-aid system along the yatra route and efficient evacuation services.

Limitations

1. Retrospective Nature: Since the study relies on hospital records, the actual number of cases may be underreported, as some pilgrims may have sought treatment at smaller clinics or returned home without hospitalization.
2. Limited Follow-Up: The study lacks post-discharge follow-up data, making it difficult to assess long-term outcomes of discharged patients.
3. Variability in Pre-Yatra Health Status: The dataset lacks detailed pre-yatra medical histories, making it challenging to fully assess pre-existing risk factors for cardiac and high-altitude illnesses.
4. Exclusion of Non-Admitted Cases: Many pilgrims with mild symptoms may not have required hospital admission, potentially skewing the severity distribution of cases in the analysis.
5. Cost Data Limitations: The economic analysis is based on hospital-reported expenses and may not capture indirect costs, such as loss of income or travel expenses for patients and families.

CONCLUSION

This study provides comprehensive insights into the medical emergencies encountered during the Shri Amarnathji Yatra, emphasizing the need for enhanced medical preparedness, pre-yatra screening, rapid intervention strategies, and cost-effective healthcare solutions. High-altitude illnesses, cardiovascular emergencies, and trauma-related injuries accounted for the majority of hospitalizations, with delayed intervention significantly worsening survival rates.

Key recommendations

- Mandatory pre-yatra cardiac screening for high-risk individuals to prevent AMI-related deaths.
- Deployment of oxygen therapy units at strategic locations to manage HAPE effectively.
- Enhancing trauma prevention strategies through safety regulations for horse riders, improved pathways, and emergency response teams.
- Strengthening base camp healthcare infrastructure to reduce referral burdens on tertiary centers.

By implementing these strategies, the burden on tertiary hospitals can be minimized, patient outcomes can be improved, and overall yatra safety can be enhanced. Future studies should focus on prospective cohort analyses with follow-up assessments to evaluate long-term health outcomes of yatra pilgrims.

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