Open Access Library Journal
2025, Volume 12, e13470
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Retrospective Analysis of Hospitalizations in the Cardiac Intensive Care Unit

Ali Elalaoui Elabidi, Mohamed El Minaoui

Faculty of Medicine and Pharmacy, Ibn Zohr Academy, Agadir, Morocco
Email: elalaoui.ea@gmail.com

How to cite this paper: Elabidi, A.E. and El Minaoui, M. (2025) Retrospective Analysis of Hospitalizations in the Cardiac Intensive Care Unit. *Open Access Library Journal*, **12**: e13470.
https://doi.org/10.4236/oalib.1113470

Received: April 21, 2025
Accepted: June 27, 2025
Published: June 30, 2025

Abstract

This retrospective study analyzes 670 hospitalizations in the Cardiac Intensive Care Unit (CICU) at Joseph Imbert Hospital Center in Arles, France, between December 2022 and December 2023. The objective was to evaluate patient profiles, reasons for admission, length of stay, and outcomes, including mortality and readmission. The most common causes of admission were Acute Coronary Syndrome (ACS, 28%) and supraventricular tachycardia (17%). The median age was 73.4 years, and 60% of admissions were male. The in-hospital mortality rate was 4.18%, increasing with age, and reached 90% in patients with cardiogenic shock. Non-cardiac causes such as pneumonia and COPD accounted for 32% of in-hospital deaths. Hemodynamic and respiratory failures were the most fatal during hospitalization. The study highlights the need for improved triage and orientation of patients with respiratory pathologies and better post-discharge monitoring, especially for those with heart failure.

Subject Areas

Cardiology

Keywords

Cardiac Intensive Care Unit, Myocardial Infarction Mortality Reduction Reperfusion Techniques Acute Infarction Treatment Heart Failure Management

1. Introduction

The first description of what would later be known as the coronary care unit was presented to the British Thoracic Society in July 1961 [1]. The goal of this unit was to group patients suffering from myocardial infarction and train personnel to administer electrical shocks and treat arrhythmias. These concepts were well re-

ceived by the team of doctors Malcolm Whyte and Gaston Bauer at Sydney Hospital, who provided the beds, equipment, and necessary training for the staff.

The benefit of this patient grouping and the training of doctors and nurses in electric shock administration was demonstrated in a 1967 study [2], which showed a decrease in the mortality rate of patients admitted to the coronary care unit, down to around 15%.

The evolution of coronary reperfusion techniques, first thrombolysis and then angioplasty techniques, has contributed to reducing the mortality rate from myocardial infarction. Today, Acute Coronary Syndrome (ACS) can be considered a condition with a low risk of mortality.

Improvements in the acute myocardial infarction treatment techniques, the development of pacing and defibrillation techniques, and the management of heart failure have not only reduced the mortality associated with this condition but also expanded the capabilities of cardiac intensive care units to include the management of other heart diseases (valvular diseases, arrhythmias, conduction disorders, etc.).

Our goal is to identify the patient population in the Cardiac Intensive Care Unit (CICU) and clarify their characteristics (age, mortality, etc.). To answer this question, we conducted a retrospective study in the cardiology department of the Joseph Imbert Hospital Center in Arles over a 12-month period.

We analyzed all hospitalizations in the CICU, regardless of the reasons and duration, and also evaluated the progression and mortality of patients with a follow-up period ranging from 6 to 18 months.

2. Methodology

We conducted a retrospective analysis of all hospitalizations in the Cardiac Intensive Care Unit (CICU) at Joseph Imbert Hospital in Arles over a 12-month period, from December 2022 to December 2023. No exclusion criteria were applied; all patients admitted during this period were included. This inclusive approach was intentionally chosen to identify potential admission errors—particularly the misclassification of non-cardiac conditions—and to evaluate their impact on clinical outcomes.

Cardiogenic shock was defined according to Stage C of the SCAI classification, which includes patients requiring vasopressor support to maintain adequate cardiac output.

Patient data were collected from the hospital's electronic health records using the AXIGATE software. Diagnostic coding and clinical decision-making were conducted as part of daily multidisciplinary staff meetings in the cardiology department, involving attending physicians and the department head. Each patient's case was reviewed and discussed collectively, and final diagnoses were determined by consensus, ensuring diagnostic consistency and inter-rater reliability.

The data extracted from AXIGATE were complete and systematically documented, with no significant missing information observed during the review pro-

cess. Only primary diagnoses were included in the analysis; secondary or associated diagnoses were excluded. Several predefined categories were used to classify the reasons for CICU admission, and primary diagnoses were refined following admission based on clinical evolution.

3. Ethical Approval

This retrospective observational study was conducted using anonymized patient data extracted from medical records. In accordance with French legislation, and as no direct patient contact or intervention was involved, ethical approval and individual patient consent were not required. The study complied with institutional data protection policies and was carried out under the supervision of the cardiology department at Joseph Imbert Hospital.

4. Objective of This Thesis

A retrospective analysis of hospitalizations in the CICU of the Joseph Imbert Hospital Center to better understand the specifics of the patients: the reasons for admission, length of stay, and mortality rates; identification of the main causes of death during and after the stay in the CICU. The specific objective was to highlight cases of misorientation of patients and the impact on their prognosis.

5. Results

In this study, 670 patients were directly admitted to the CICU (See Table 1 for age and gender distribution) between December 2022 and December 2023, representing 10% of all hospitalizations from the emergency department.

92 patients, or 13% of the hospitalizations, were direct admissions or transfers.

Table 1. Distribution of patients by age range and gender.

Age range	Female %	Male %	Total
19 - 28	3 (50%)	3 (50%)	6
29 - 38	3 (27%)	8 (73%)	11
39 - 48	9 (33%)	18 (67%)	27
49 - 58	12 (23%)	40 (77%)	52
59 - 68	38 (35%)	72 (65%)	110
69 - 78	40 (31%)	87 (69%)	127
>79	165 (49%)	172 (51%)	337
Total	270 (40%)	400 (60%)	670

The median age was 73.39 years, with 50% of patients being 80 years or older. 60% of admissions were male.

Admissions were categorized into four major groups, these are detailed in Table 2.

1) Chest Pain: Patients admitted for chest pain were primarily diagnosed with ST-segment elevation myocardial infarction (STEMI), non-STEMI, pulmonary

embolism, and myopericarditis.

2) Hemodynamic Failures: These patients were diagnosed with global heart failure, cardiogenic shock, and endocarditis.

3) Rhythm Failures: These patients were diagnosed with syncope, heart block, sinus dysfunction, and sustained ventricular tachycardia.

4) Respiratory Distress: These patients were diagnosed with acute pulmonary edema (OAP), ARDS, COPD, and pneumonia.

Table 2. Main hospitalization categories and their percentages.

Hospitalization reason	Number of patients	Percentage %
Chest pain	248	37%
Rhythm failure	205	31%
Hemodynamic failure	112	17%
Respiratory distress	105	16%
Total	670	100%

We classified patients by these categories of functional symptoms to highlight errors in the orientation of non-cardiac pathologies.

Table 3. Reasons for hospitalization for chest pain and their distribution in percentages.

Hospitalization reason	Number of patients	Percentage %
Non-STEMI	170	25.37%
Pulmonary embolism (PE)	56	8.36%
STEMI	14	2.09%
Myopericarditis	8	1.19%
Total	248	37%

Acute coronary syndromes (ACS) are the most frequent reason for hospitalization (See Table 3 for chest pain-related diagnoses), with 184 patients (28.06% of all hospitalizations). All ACS patients admitted to the CICU were either NTEMI or STEMI cases seen late and/or rejected for rescue angioplasty. Our center does not perform coronary angiography, and STEMI cases are systematically referred to a center that performs angioplasty as soon as the diagnosis is made, often by the SMUR team.

Table 4. Reasons for hospitalization for rhythm failures and their distribution in percentages.

Hospitalization reason	Number of patients	Percentage %
Supraventricular tachycardia (SVT)	117	17.46%
Heart block (BAV)	30	4.48%
Sinus dysfunction	9	1.34%
Sustained ventricular tachycardia	4	0.60%
Syncope/lipothymia (without rhythm diagnosis)	45	6.72%
Total	205	31%

The second major reason for hospitalization is supraventricular tachycardia, (See Table 4 for rhythm failure details) which accounts for 17% of all hospitalizations. The majority of these cases were atrial fibrillation, followed by atrial flutter and a few cases of junctional tachycardia (JT).

Patients admitted for syncope or lipothymia represent 6.72% of all hospitalizations. This group also includes patients who experienced syncope or lipothymia without an identifiable cause during their stay in the CICU.

Table 5. Reasons for hospitalization for hemodynamic failures and their distribution in percentages.

Hospitalization reason	Number of patients	Percentage %
Global heart failure	96	14.33%
Cardiogenic shock	10	1.49%
Endocarditis	6	0.90%
Total	112	17%

Hemodynamic failures accounted for 17% of CICU hospitalizations (See Table 5 for hemodynamic failure details). Among these, global heart failure was the most common (14.33%), followed by cardiogenic shock (1.49%) and endocarditis (0.90%).

Table 6. Reasons for hospitalization for respiratory distress and their distribution in percentages.

Hospitalization reason	Number of patients	Percentage %
Acute pulmonary edema (OAP)	94	14.03%
Acute respiratory distress syndrome (ARDS)	6	0.90%
Chronic obstructive pulmonary disease (COPD)	3	0.45%
Pneumonia	2	0.30%
Total	105	16%

Respiratory distress represented 16% of CICU hospitalizations (See Table 6 for respiratory distress breakdown). Acute pulmonary edema (OAP) was the most common, accounting for 14.03% of cases. Other respiratory distress cases initially presented with left heart failure symptoms, characterized by elevated left ventricular filling pressures (LVFP). However, the evolution of these patients highlighted a pulmonary component, such as pneumonia and COPD, as the primary pathology. ARDS, COPD, and pneumonia are less frequent, representing 0.90%, 0.45%, and 0.30% of admissions, respectively.

The median length of stay in the CICU was 5 days (See Table 7 for distribution of length of stay), with more than half of the patients staying for fewer than 6 days.

ARDS (Acute Respiratory Distress Syndrome) patients require an average of **19 days** of hospitalization (See Table 8 for average length of stay by pathology), while patients with **Acute Coronary Syndrome (ACS)** stay an average of **5 days** in the hospital.

Table 7. Length of stay in the CICU.

Length of stay (Days)	Number of patients
1 - 3	224
4 - 6	177
7 - 10	122
>10	147
Total	670

Table 8. Average length of stay by pathology.

Hospitalization reason	Average length of stay (Days)
ARDS	19.3
Cardiogenic shock	10.9
Global heart failure	10.1
Sinus dysfunction	9.9
OAP	8.5
Pulmonary embolism (PE)	7.8
Heart block (BAV)	7.5
COPD	6.3
Supraventricular tachycardia	5.9
Endocarditis	5.8
Sustained ventricular tachycardia	5.5
ACS	5.4
Myopericarditis	4.6
Pneumonia	4.5
Syncope/lipothymia	3.8
Total	7.0

The longest hospitalization duration is seen in **endocarditis** patients, with an average of **35 days** after an average of **5 days** in the ICU.

Out of the **624 patients** who survived until discharge, **23 (3%)** were readmitted to the coronary intensive care unit within **30 days**. The majority of readmissions were due to **heart failure (50%)**.

The mortality rate was higher in **men** (See Table 9 for mortality by sex), accounting for **65.2%** of deaths.

Table 9. Mortality by sex.

Sex	Number of patients
F (Female)	16
M (Male)	30
Total	46

Among the 46 patients who died, 30 were men (65.2%) and 16 were women (34.8%). Considering the overall cohort included 60% men and 40% women, we performed a chi-square test to assess the association between sex and mortality. The result was not statistically significant ($p > 0.05$), indicating that the observed difference may be due to chance rather than a true sex-related effect.

Table 10. Mortality by Hospitalization Reason.

Reason for hospitalization	Total deceased	Mortality during hospitalization	Mortality after discharge
Chest pain	12 (22%)	3 (10.71%)	9 (33.33%)
Rhythm failure	8 (15%)	3 (10.71%)	5 (18.51%)
Hemodynamic failure	18 (33%)	11 (39.28%)	7 (25.92%)
Respiratory distress	17 (31%)	11 (39.28%)	6 (22.22%)
Total	55	28	27

- The overall mortality in the CICU was 55 patients, representing 8% of the total hospital admissions (See Table 10 for mortality by reason of hospitalization). Among the various conditions, hemodynamic and respiratory failures were the most fatal during hospitalization (See Table 11 for mortality by specific pathology), while chest pain with ACS was the least fatal.

Table 11. Mortality by Pathology.

Reason for hospitalization	Number of patients	Mortality during hospitalization	Mortality after discharge	12-month mortality
AV Block (BAV)	30	0	1	1 (3.33%)
COPD (BPCO)	3	0	0	0
Cardiogenic shock	10	9	0	9 (90%)
Sinus dysfunction	9	1	0	1 (11.11%)
Endocarditis	6	1	0	1 (16.66%)
Pulmonary embolism (EP)	56	1	1	2 (3.57%)
Global heart failure	96	1	7	8 (8.33%)
Myopericarditis	8	0	0	0
Pulmonary edema (OAP)	94	10	6	16 (17.02%)
Pneumonia	2	0	0	0
ACS -	170	2	7	9 (5.2%)
ACS +	14	0	1	1 (7.14%)
ARDS (SDRA)	6	1	0	1 (16.6%)
Sustained VT (TV)	4	0	0	0
Supraventricular tachycardia (TSV)	117	2	4	6 (5.12%)
Syncope	45	0	0	0
Total	670	28	27	55 (8%)

ACS - : Non-ST-Elevation Myocardial Infarction (NSTEMI); ACS + : ST-Elevation Myocardial Infarction (STEMI).

Table 12. Summary of mortality during hospitalization.

Age range	Survival	Mortality after discharge	Mortality during hospitalization	Total
19 - 33	8	0	0	8
34 - 48	36	0	0	36
49 - 63	101	1 (3.7%)	0	102
64 - 78	179	3 (11.11%)	5 (17.85%)	187
>79	291	23 (85.18%)	23 (82.14%)	337
Total	615	27	28	670

- **28 patients** died during their hospitalization in the USIC, accounting for approximately **4.18%** of admissions.
- Among these deaths, **14** were attributed to a cardiac origin (See Table 13 for detailed causes of death) (50% of the deaths), with **9 patients** (32.14%) dying from cardiogenic shock, and **5 patients** (17.86%) dying from terminal heart failure.
- Additionally, **9 deaths** (32.14%) were of pulmonary origin, including **5 patients** (17.86%) who died from pneumonia, **2 patients** (7.14%) from COPD decompensation, and **2 patients** (7.14%) from pulmonary neoplasms.
- The remaining **5 deaths** (17.86%) included **1 patient** with metastasized neoplasm, **2 patients** with uncontrolled sepsis, and **2 patients** with multivisceral failure.

Table 13. Causes of death during hospitalization.

Cause of death	Number of patients	Percentage (%)
Cardiogenic shock	9	32.14%
Terminal heart failure	5	17.86%
Pneumonia	5	17.86%
COPD	2	7.14%
Pulmonary neoplasia	2	7.14%
Endometrial neoplasia with metastasis	1	3.57%
Uncontrolled sepsis	2	7.14%
Multivisceral failure	2	7.14%
Total	28	100%

6. Discussion

The retrospective analysis of hospitalizations in the Cardiac Intensive Care Unit (CICU) of Joseph Imbert Hospital in Arles over a 12-month period reveals significant data on reasons for hospitalization, length of stay, mortality, and the epidemiological characteristics of patients. These results should be compared with available literature data to understand their relevance and clinical implications.

6.1. Epidemiology: Sex and Age

The median age of our cohort was 73.39 years, with a significant proportion of patients aged 80 years or older and a male predominance (60%). This demographic profile aligns with the studies of Katz *et al.* (2010) [3], which also found an aging and predominantly male population in modern cardiac intensive care units. These observations are consistent with general trends where cardiovascular diseases are more frequent and severe in older men. Women accounted for 40% of admissions, and although this percentage was lower than that of men, it is important to note that women admitted to the CICU tend to be older than their male counterparts. This finding is consistent with Morrow *et al.* (2012), who observed that women develop cardiovascular diseases later in life than men.

6.2. Reasons for Hospitalization and Length of Stay

Acute coronary syndromes (ACS) and rhythm disorders (SVT) accounted for 27.46% and 17.46% of hospitalizations, respectively. These rates are consistent with trends observed in other studies, where ACS and rhythm disorders are frequently the main reasons for CICU admissions. Specifically, Katz *et al.* (2010) [3] documented a similar predominance of ACS in coronary intensive care admissions, highlighting the ongoing importance of this pathology despite advances in coronary reperfusion and angioplasty. We recorded each patient's initial reason for admission to the CICU. Thus, if the diagnosis evolved or another pathology was discovered during hospitalization, these modifications were not considered in our analysis. The median length of stay was 5 days, with the majority of patients (56%) hospitalized for less than 6 days. ARDS required the longest hospitalization duration (19.3 days). Patients with endocarditis required an average hospitalization of 35 days, with an average stay of 5 days in the CICU, reflecting the complexity and severity of this pathology, which requires extensive investigations and prolonged antibiotic therapy. Conversely, ACS patients had an average length of stay of 5.39 days, indicating efficient and rapid management thanks to advances in coronary reperfusion and angioplasty. This disparity is consistent with the clinical requirements and specific treatment protocols for each condition, as shown in the studies of Katz *et al.* (2010) [3], who also observed a significant reduction in hospitalization duration for ACS due to advancements in intensive cardiac care.

6.3. Mortality and Readmissions

Lethality was higher in men (65.2%). However, when adjusted for their proportion in the total population (60% of admissions), a chi-square test showed that this difference was not statistically significant ($p > 0.05$), suggesting no strong sex-related effect on mortality in this cohort.

Overall mortality in the CICU was 8%, with significant variations depending on the reason for hospitalization. Hemodynamic failures and respiratory distress had the highest mortality rates during hospitalization, accounting for 39.28% of deaths. In contrast, acute coronary syndromes (ACS) had the lowest in-hospital

mortality rate, at only 7.1%. Post-discharge mortality remained high for patients suffering from global heart failure and pulmonary edema, with rates of 25.9% and 22.2%, respectively. This reflects the progress made in ACS treatment and the persistent challenges associated with heart failure despite an increasingly sophisticated therapeutic arsenal, including the four-pillar medications, resynchronization therapies, and cardiac rehabilitation techniques. Our study data show that a large proportion of deaths occurring during hospitalization in the CICU are not due to purely cardiac causes. Indeed, the most frequent causes of mortality include non-cardiac pathologies such as uncontrolled pneumonia and severe decompensated COPD. Moreover, it is important to note that most deaths after CICU discharge occur in other hospital departments due to non-cardiac causes. Survival and mortality analysis by age group (See **Table 12** for mortality by age) reveals that both in-hospital and post-discharge mortality increases significantly with age. For example, in patients aged 64 to 78 years, in-hospital mortality is 17.85% and post-discharge mortality is 11.11%, whereas for patients over 79 years old, these rates rise to 82.14% and 85.18%, respectively. In terms of readmissions, 3% of patients who survived until hospital discharge were readmitted to the cardiac intensive care unit within 30 days. Most readmissions involved cases of heart failure (HF) (50%), highlighting the importance of continued management and post-hospitalization monitoring for these high-risk patients. Historical studies, such as those of Julian (1961) and Killip & Kimball (1967) [1] [4], have shown a significant reduction in patient mortality thanks to the establishment of coronary care units and advances in myocardial infarction treatment techniques. The ACS mortality rate in our study (7%) aligns with contemporary observations, indicating a continued improvement in intensive cardiac care.

The overall in-hospital mortality rate in our cohort was 8%, which falls within the range reported by recent multicenter studies. For example, Zobel *et al.* (2012) [5] reported a mortality rate of 9.2% in a cardiac intensive care unit, while Ratcliffe *et al.* (2014) [6] observed a rate of 7.5% across multiple centers. These figures suggest that the mortality observed in our single-center study is consistent with broader findings and reinforces the validity of our results in the context of current clinical practice.

6.4. Patient Orientation

The orientation of patients with respiratory distress to the CICU presents specific challenges. The cardiac component is difficult to assess in the first hours, and diuretic therapeutic tests along with responses to NIV treatment are the main orientation criteria applied in our department. Indeed, pathologies such as pneumonia, COPD, and other pulmonary conditions are frequent differential diagnoses of left heart failure. Directing these patients to the CICU can worsen their prognosis, as care in a cardiac unit does not always optimally meet complex respiratory needs. Although cardiac involvement is present, it is often minimal and resolves quickly, leaving the pulmonary component as the main factor of morbidity and

mortality. Thus, better orientation of these patients to an intensive care unit (ICU) or general intensive care could improve their prognosis by providing care more suited to their pulmonary needs.

7. Limitations

This study has several limitations. First, it is a single-center study, which may limit the generalizability of our findings to other hospitals or healthcare systems. Second, the retrospective nature of the study relies on existing medical records, which may introduce information bias despite careful data collection and coding. Third, although we followed patients for a period of 6 to 18 months, some long-term outcomes such as rehospitalization or late mortality may have been missed. Lastly, the exclusion of associated diagnoses and the focus solely on primary diagnoses might have underestimated the clinical complexity of certain patients.

8. Conclusion

The retrospective analysis of hospitalizations in the CICU at Joseph Imbert Hospital shows that mortality remains particularly high in elderly patients, especially those over 79 years old. While acute coronary syndromes (ACS) have become a low-risk pathology due to medical advancements, hemodynamic and respiratory failures remain major challenges. Patients with heart failure show increased mortality, necessitating improved management and prevention strategies. These results highlight the importance of continuous and optimized care for complex cardiac pathologies. Thus, better patient orientation could improve their prognosis by providing care better suited to their pulmonary needs, particularly in elderly patients, to further reduce CICU mortality.

Conflicts of Interest

The authors declare no conflicts of interest.

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