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Clinical outcomes after unprotected left main coronary artery occlusion: A retrospective multicentre cohort analysis

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Abstract

Aims: Unprotected left main coronary artery (ULMCA) occlusion is a rare and disastrous condition with scarce data on presentation and outcomes. Herein, we report data on patients presenting with acute coronary syndrome due to ULMCA occlusion at four different institutions.

Methods: This is an international multicentre observational study. Baseline characteristics were retro- and prospectively collected. Clinical follow-up was prospective. The primary outcome was in-hospital death. Patients surviving the index hospitalization were compared with nonsurvivors to find predictors of survival.

Results: The study population consisted of 55 patients. Eight patients (15%) died in the cath lab, and 23 (42%) died in hospital. Three (6%) deaths were noncardiac and due to major bleeding. Thirty-two (58%) patients survived the index hospitalization and were discharged. These patients were followed for a median of 17.5 months during which three cardiac deaths occurred. Repeat revascularization was performed in 25% ($n = 8$). Overall mortality at maximum follow-up was 47% ($n = 26$). The only significant predictor for hospital survival was left ventricular ejection fraction (odds ratio [OR]: 1.10 (per 1 point increase); 95% confidence interval [CI]: 1.02–1.19; $p = 0.02$).

Conclusion: ULMCA occlusion carries a high short-term mortality. Patients who survive index hospitalization have similar mortality rates as compared with other st elevation myocardial infarction patients.

KEYWORDS

acute myocardial infarction, cardiogenic shock, left main coronary artery occlusion, percutaneous coronary intervention

Abbreviations: ACS, acute coronary syndrome; BARC, Bleeding Academic Research Consortium; CPR, cardiopulmonary resuscitation; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; LAD, left anterior descending artery; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention; pVAD, percutaneous ventricular assist device; RCA, right coronary artery; ST, stent thrombosis; TLR, target lesion revascularisation; ULMCA, unprotected left main coronary artery.

1 | INTRODUCTION

Significant unprotected left main coronary artery (ULMCA) stenosis is encountered in 3%–10% of patients undergoing coronary angiography.[1–3] Complete occlusion of the ULMCA is rare and likely a very common cause of sudden cardiac death.[4] Consequently, most patients with acute ULMCA obstruction die before reaching hospital. While the revascularisation strategy should be discussed in stable patients,[5,6] percutaneous coronary intervention (PCI) remains the preferred therapeutic option in acute coronary syndromes (ACS), especially in complete obstruction with hemodynamic instability.

Clinical data on outcomes in patients with occluded ULMCA is limited.[7–9] Reported mortality rates are massive with more than half of patients dying within the first few hours after admission.[8,9] Most publications predate modern management strategies of first-responder resuscitation networks, prehospital medical resuscitation teams, effective st elevation myocardial infarction (STEMI)-networks, facilitated PCI, potent antiplatelet drugs, drug-eluting stents, as well as percutaneous assist devices.

We sought to assess clinical presentation, management strategies, and clinical outcomes in patients presenting with ACS due to ULMCA occlusion and to identify independent predictors for in-hospital mortality.

2 | METHODS

2.1 | Study design and patient population

This is a retro- and prospective multicentre observational study. All patients treated for ACS due to ULMCA occlusion from 2007 to 2020 were retrieved from the participating centers, and included in the analysis. Medical records including prehospitalization medical history, physical examination, laboratory tests, coronary angiography and ventriculography, 12-lead ECG, PCI reports, as well as postprocedural echocardiography were reviewed.

The study complied with the Declaration of Helsinki regarding investigations in humans and was approved by the institutional ethics committee at University & Hospital, Fribourg, Switzerland (003-REP-CER-FR).

2.2 | Definitions

ULMCA occlusion was defined as a thrombolysis in myocardial infarction (TIMI) flow of 0 or 1 in the left main coronary artery in the absence of a patent coronary artery graft on the left-sided circulation. *Acute heart failure* was defined using the Killip–Kimball classification.[10] *Cardiogenic shock* was defined as sustained hypotension (systolic blood pressure [BP] < 90 mmHg or a drop of >30 mmHg from the usual value lasting >30 min) accompanied by signs of tissue hypoperfusion in the setting of clinically adequate or elevated left ventricular (LV) filling pressures.[11] *Technical success* was defined as successful deployment of a stent in the target lesion. *Procedural success* was defined as ULMCA revascularization with ≤30% residual diameter stenosis by quantitative coronary angiography, without major procedural or postprocedural adverse events during hospitalization (death, myocardial infarction, emergency target vessel revascularization, or acute stent thrombosis [ST]).

Death was classified as either cardiac or noncardiac, according to the Academic Research Consortium (ARC) definition.[11] Deaths that could not be classified were considered cardiac. *Target lesion revascularization (TLR)* was defined as any repeat PCI of the target lesion. *Definite, probable, and possible stent thromboses* were determined according to the ARC definitions.[11] Major bleeding was defined according to the Bleeding Academic Research Consortium (BARC) classification, BARC 3–5.[12] Myocardial infarction during follow-up was defined according to the ARC for coronary stent trials.

2.3 | Endpoints

The primary endpoint was all-cause in-hospital mortality. Key secondary endpoints were cardiac death, myocardial infarction, ST, repeat revascularization, major bleeding, and periprocedural stroke at maximum follow-up.

2.4 | Follow-up and event adjudication

The maximally available follow-up was provided for each patient. Patients were followed by phone or clinic visits. Data on clinical follow-up for patients that could not be contacted was gathered through the referring physician or through consultation of the hospital's local database if available. Events were adjudicated centrally at the University and Hospital Fribourg.

2.5 | Statistical analysis

Categorical variables are reported as counts and percentages; continuous variables are reported as means and standard deviations or medians with 25%–75% interquartile range according to their distribution. Normality was assessed by visual inspection of histograms and the computation of Q–Q plots. Continuous variables were analyzed using the Student *t* test or the Wilcoxon rank-sum test per distribution. Categorical variables were compared using the χ^2 or the two-proportion *z*-test. Survival free from the occurrence of clinical endpoints was assessed by computation of the Kaplan–Meier curves. Landmark analysis was performed for 1 month. Variables were compared between patients that died in hospital and those alive upon hospital discharge.

We computed a logistic regression model to identify predictors for survival beyond the index hospitalization. We considered all pretreatment variables and used backward stepwise regression with an initial inclusion criterion of $p < 0.25$ and an exclusion criterion of

$p > 0.15$. A conservative approach was implemented with an upper limit of 1 variable per 10 events.

All statistical analyses were performed using dedicated software (STATA 13; Stata Corp) at a two-tailed significance level of $\alpha = .05$.

All authors have read and approved the manuscript, and are responsible for the design and conduct of this study, study analyses, the drafting and editing of the article, and its final contents.

3 | RESULTS

Between January 2007 and June 2020, 53,605 PCIs were performed at our institutions. ULMCA occlusion was found in 55 patients (0.1%).

3.1 | Baseline patient characteristics and clinical presentation

Patient baseline characteristics are shown in Table 1. Twenty-three patients (42%) died in hospital and 32 patients (58%) were discharged alive. Mean age was 65.3 ± 12.4 years and 78% ($n = 43$) were men. Arterial hypertension was found in 38% ($n = 21$). The most frequent clinical presentation was cardiogenic shock (with or without STEMI) and was found in 49% ($n = 27$) of patients. Overall, 44% ($n = 24$) of patients required cardiopulmonary resuscitation. Cardiopulmonary resuscitation (CPR) was initiated before coronary angiography in 22% ($n = 12$) of patients. CPR was more frequently attempted in patients that subsequently died in-hospital (61% [$n = 14$] vs. 31% [n = 10], $p = 0.03$). Mean left ventricular ejection fraction (LVEF) at presentation was 30 ± 16%. Patients dying in hospital showed a significantly worse systolic LV function (21 ± 5% vs. 34 ± 17%, $p = 0.02$).

3.2 | Procedural characteristics

Procedural characteristics and information on mechanical support are provided in Table 2. Preprocedural TIMI-flow was 0 in 85% ($n = 47$) of patients. Patients that died in hospital had a numerically higher proportion of TIMI-flow 0 than patients having survived beyond the index hospitalization (96% [$n = 22$] vs. 78% [$n = 25$], $p = 0.07$). The use of mechanical support was high overall with 58% ($n = 32$) of patients receiving some form of circulatory support. Intra-aortic balloon pump (IABP) as stand-alone circulatory support was most frequently used (25% of patients ($n = 14$). Circulatory support was used in 20% ($n = 11$) preprocedural and introduced in 38% ($n = 21$) during or after PCI. Data on vasoactive drugs were missing for 15 patients. Vasoactive drugs were used in 70% ($n = 28/40$) of patients of which 55% ($n = 22/40$) needed ionotropic support. Pharmacological circulatory support was initiated before PCI in 42% ($n = 17/40$) of patients. Seventy-six percent ($n = 42$) of patients had distal/bifurcation lesions of the left main

TABLE 1 Baseline patient characteristics.

	All patients ($N = 55$)	Deceased in hospital ($N = 23$)	Survived hospital ($N = 32$)	p Value
Age mean ± SD	65.3 ± 12.4	65.7 ± 10.3	65.0 ± 13.8	0.85
Male gender, *n* (%)	43 (78)	18 (78)	25 (78)	1.00
Cardiovascular risk factors				
Arterial hypertension, *n* (%)	21 (38)	6 (26)	15 (47)	0.16
Diabetes mellitus, *n* (%)	11 (20)	7 (30)	4 (13)	0.17
Dyslipidaemia, *n* (%)	21 (38)	4 (17)	17 (53)	0.01
Family history, *n* (%)	7 (13)	2 (9)	5 (16)	0.69
Smoking, *n* (%)	23 (41)	11 (48)	12 (38)	0.58
Clinical presentation				
NSTEMI, *n* (%)	2 (4)	0 (0)	2 (6)	0.22
STEMI (without CS), *n* (%)	18 (33)	10 (43)	8 (25)	0.15
CS, *n* (%)	27 (49)	9 (39)	18 (56)	0.21
SCD, *n* (%)	8 (15)	4 (17)	4 (13)	0.61
Any CPR, *n* (%)	24 (44)	14 (61)	10 (31)	0.03
CPR for cardiac arrest before cathlab, *n* (%)	12 (22)	7 (30)	5 (16)	0.19
LVEF % (periprocedural), mean ± SD	30 ± 16	21 ± 5	34 ± 17	0.02
Pain-to-needle time in minutes, median (IQR 25%–75%)	140 (110–240)	135 (105–203)	140 (113–248)	0.64

Abbreviations: CPR, cardiopulmonary resuscitation; CS, cardiogenic shock; IQR, interquartile range; LVEF, left ventricular ejection fraction; SCD, sudden cardiac death.

TABLE 2 Procedural characteristics.

	All patients (*N* = 55)	Deceased in hospital (*N* = 23)	Survived hospital (*N* = 32)	*p* Value
Preprocedural characteristics				
TIMI flow				
0, *n* (%)	47 (85)	22 (96)	25 (78)	0.07
1, *n* (%)	8 (15)	1 (4)	7 (22)	0.07
2, *n* (%)	0 (0)	0 (0)	0 (0)	1.00
3, *n* (%)	0 (0)	0 (0)	0 (0)	1.00
Any mechanical support, *n* (%)	32 (58)	14 (61)	18 (56)	0.73
IABP alone, *n* (%)	14 (25)	3 (13)	11 (34)	0.07
pVAD and/or ECMO alone, *n* (%)	11 (20)	5 (22)	6 (19)	0.03
pVAD/ECMO and IABP, *n* (%)	7 (13)	6 (26)	1 (3)	0.01
Procedural characteristics				
Lesion localization				
Ostial/midshaft, *n* (%)	13 (24)	5 (22)	8 (25)	0.78
Distal/bifurcation, *n* (%)	42 (76)	18 (78)	24 (75)	0.78
Calcifications present, *n* (%)	16 (29)	7 (30)	9 (28)	0.85
Procedural success, *n* (%)	40 (73)	15 (65)	25 (78)	0.29
Technical success, *n* (%)	45 (82)	19 (83)	26 (81)	0.90
Predilatation, *n* (%)	28 (51)	9 (39)	19 (59)	0.14
Manual thrombectomy	24 (44)	14 (61)	10 (31)	0.03
POBA, *n* (%)	5 (9)	0 (0)	5 (16)	0.04
Stent, *n* (%)	45 (82)	19 (83)	26 (81)	0.90
Nb of stent in ULM, *n* (%)	1.16 ± 0.42	1.16 ± 0.50	1.15 ± 0.37	0.93
Single stent in ULM, *n* (%)	39 (71)	17 (74)	22 (69)	0.68
Dual stent in ULM, *n* (%)	6 (12)	3 (13)	3(9)	0.67
TAP-technique, *n* (%)	4 (8)	2 (9)	2 (6)	0.73
T-technique, *n* (%)	2 (4)	1 (4)	1 (3)	0.81
Vessel treated other than ULM, *n* (%)				
LAD, *n* (%)	16 (29)	7 (30)	9 (28)	0.85
LCX, *n* (%)	10 (18)	7 (30)	3 (9)	0.05
RCA, *n* (%)	2 (4)	2 (9)	0 (0)	0.09
CABG, *n* (%)	3 (6)	0 (0)	3 (9)	0.13
Glycoprotein IIb/IIIa Inhibitor use	27 (49)	12 (52)	15 (47)	0.70
Postprocedural characteristics				
TIMI flow				
0, *n* (%)	1 (2)	1 (4)	0 (0)	0.23
1, *n* (%)	1 (2)	1 (4)	0 (0)	0.23
2, *n* (%)	7 (13)	3 (13)	4 (12)	0.95
3, *n* (%)	46 (83)	18 (78)	28 (88)	0.36

Abbreviations: CABG, coronary artery bypass grafting; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; LAD, left anterior descending artery; LCX, left circumflex coronary artery; POBA, plain old balloon angioplasty; pVAD, percutaneous ventricular assist device; RCA, right coronary artery; ULM, unprotected left main.

coronary artery and 24% ($n = 13$) presented with ostial/midshaft lesions. There were no differences between in-hospital survivors and patients that died in hospital in regard to lesion localization (ostial/midshaft: 25% [$n = 8$] vs. 22% [$n = 5$], $p = 0.78$; distal/bifurcation: 75% [$n = 24$] vs. 78% [n = 18], $p = 0.78$).

Procedural success was obtained in 73% ($n = 40$) and technical success in 82% ($n = 45$) of patients. Manual thrombectomy was more frequently attempted in patients that died in hospital than in hospital survivors (61% ($n = 14$) vs. 31% ($n = 10$), $p = 0.03$). Thirty-nine patients (71%) received only one stent in the ULMCA, a double stent technique was employed in 12% ($n = 6$) of patients (four patients (7%) with TAP-technique, two patients (3%) with T-technique). In patients that had received a single stent, the left anterior descending artery was most frequently treated (29% ($n = 16$)). Glycoprotein IIb/IIIa Inhibitor use was 49% ($n = 27$) and did not differ between patients that died in hospital (52% ($n = 12$)) and those who survived the index hospitalization (47% ($n = 15$), $p = 0.70$). A normal postprocedural (TIMI 3) flow was found in 83% ($n = 46$) of patients and was evenly distributed between groups (nonsurvivors: 78% ($n = 18$) vs. hospital survivors: 88% ($n = 28$), $p = 0.36$).

3.3 | Clinical outcome

Information on clinical outcome is provided in Table 3. Out of 55 patients reaching the catheterization laboratory alive, 15% ($n = 8$) died during the procedure. All deaths were considered cardiac. Two of these patients initially presented with cardiopulmonary arrest, three with cardiogenic shock, and three patients with STEMI without cardiogenic shock. All ($n = 7$) but one patient had an initial TIMI flow of 0.

During index hospitalization 15 (27%) more deaths occurred of which 12 (22%) were considered cardiac. Of these, 87% ($n = 13$) died during the first 24 h after admission. Fatal bleeding occurred in two patients: one patient died from major bleeding 3 days after PCI (intracerebral bleeding), another from hemorrhagic shock 8 days after PCI.

Table 4 shows clinical outcomes in patients having survived the index hospitalization. The median follow-up in these patients was 17.5 months. Thirty-two (58%) patients left the hospital alive. Of these, 3 (9%) died at a median follow-up of 7.8 months. All deaths were considered cardiac. Heart transplantation was performed in 1 (3%) patient. Any repeat revascularization was performed in 25% ($n = 8$) of patients. Clinically driven TLR was necessary in 9% ($n = 3$) of patients discharged alive from hospital.

Overall survival is shown as landmark analysis in Figure 1 (landmark at 1 month).

3.4 | Predictors of in-hospital survival

The logistic regression model for the prediction of in-hospital survival identified two variables: absence of cardiogenic shock

TABLE 3 Clinical outcomes.

	N = 55
Procedural outcome	
Death, *n* (%)	8 (15)
Cardiac death, *n* (%)	8 (15)
Noncardiac death, *n* (%)	0 (0)
MI, *n* (%)	0 (0)
ST (definite/probable), *n* (%)	1 (2)
Major bleeding, *n* (%)	0 (0)
Stroke, *n* (%)	0 (0)
In-hospital outcome	
Death, *n* (%)	23 (42)
Cardiac death, *n* (%)	20 (36)
Noncardiac death, *n* (%)	3 (6)
MI, *n* (%)	3 (6)
ST (definite/probable), *n* (%)	3 (6)
Major bleeding, *n* (%)	4 (8)
Stroke, *n* (%)	2 (4)
Outcome at maximal follow-up	
Death, *n* (%)	26 (47)
Cardiac death, *n* (%)	24 (44)
Noncardiac death, *n* (%)	2 (4)
MI, *n* (%)	2 (4)
ST (definite/probable), *n* (%)	3 (6)
Major bleeding, *n* (%)	2 (4)
Stroke, *n* (%)	1 (2)

Abbreviations: MI, myocardial infarction; ST, stent thrombosis.

TABLE 4 Clinical outcomes of in-hospital survivors.

	N = 32
Follow-up (months), median (IQR)	17.5 (1–77.5)
HTx or LVAD, *n* (%)	1 (3)
Death, *n* (%)	3 (9)
Cardiac death, *n* (%)	3 (9)
Noncardiac death, *n* (%)	0 (0)
MI, *n* (%)	1 (3)
ST (definite/probable), *n* (%)	3 (9)
Any revascularization, *n* (%)	8 (25)
TLR, *n* (%)	3 (9)

Abbreviations: HTx, heart transplantation; IQR, interquartile range; LVAD, left ventricular assist device; MI, myocardial infarction; ST, stent thrombosis; TLR, target lesion revascularisation.

and/or cardiopulmonary arrest (odds ratio [OR] 0.20; 95% confidence interval [CI]: 0.03–1.66; $p = 0.14$) and LVEF (per 1% increase: OR 1.10; 95% CI: 1.02–1.19; $p = 0.02$). Only LVEF was significant, with a two-fold increase in in-hospital survival for every 10% increase in LVEF (Table 5).

4 | DISCUSSION

The main findings of the present analysis are: (1) In-hospital mortality is very high in patients presenting with ACS due to ULMCA occlusion; (2) Mid- to long-term survival in patients discharged alive after index hospitalization is encouraging; (3) a severely reduced LVEF is predictive of in-hospital mortality after ACS due to ULMCA occlusion.

In line with previously published reports, we found that only 0.1% of patients with ACS present with ULMCA occlusion. Two studies reported ULMCA occlusion in 0.6%–0.8% of all primary PCI.[8,15] Similarly, a multicentric study from Spain observed ULMCA occlusion in 0.58% of cases referred for emergent PCI.[16]

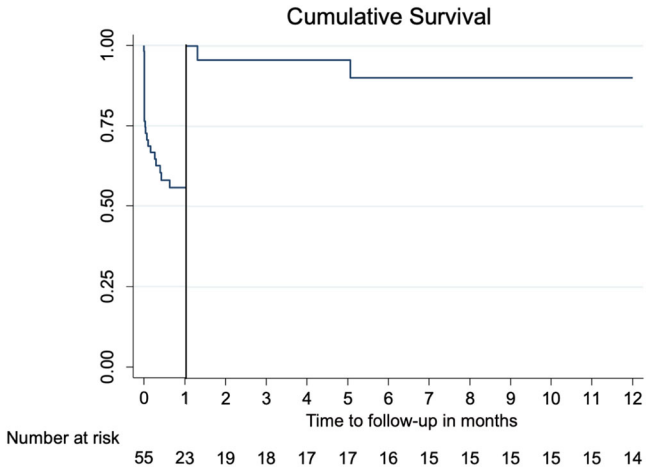

FIGURE 1 Overall survival. Landmark analysis with landmark at 1 month. [Color figure can be viewed at wileyonlinelibrary.com]

The most frequent clinical presentation was cardiogenic shock (49%), of which 44% required CPR. Cardiac arrest was the initial presentation in 15% of patients. Total ischemic time was acceptable and presented a median of 140 min. Most patients (85%) had a TIMI flow of 0 but 15% had residual TIMI 1 flow. LVEF was severely depressed, especially in patients that died in-hospital (21 ± 5%).

Cardiogenic shock was however less frequent as compared with other studies (75%–94%).[8,9,16,17] This may be explained by less stringent inclusion criteria such as defining ULMCA occlusion as a preprocedural TIMI flow of 0–1. In many previously published studies, only patients with total occlusion and TIMI 0 flow were included.

Cardiogenic shock was not an independent predictor for in-hospital mortality in our study. Similarly, Gutierrez-Barrios and colleagues[16] also discarded cardiogenic shock as independent predictor for in-hospital mortality in their multivariate analysis. They found postprocedural TIMI flow to be most predictive for the occurrence of in-hospital death. However, cardiogenic shock was identified as a predictor for long-term mortality in a recently published article reporting 1-year mortality outcomes in x (amount of patients) with total occlusion of the ULMCA.[13]

CPR is frequently needed in patients presenting for emergent PCI due to ULMCA occlusion. The need for and conduction of CPR in these patients in not ubiquitously reported in the literature. However, it has been found that up to 34.5% of ULMCA occlusion STEMI patients may present with cardiac arrest before PCI.[13] Even though predictive for in-hospital mortality in univariate analysis, when corrected for initial LVEF, cardiac arrest as presentation in out-of-hospital survivors and the need for CPR in these patients lose their predictive significance for in-hospital death. This seems to hold true even for long-term mortality.[13] To our knowledge, cardiac arrest as initial presentation has not yet been reported as a significant predictor for short- or long-term mortality in patients reaching the cath lab alive, even though this might seem counterintuitive.

We identified LVEF as sole independent predictor for in-hospital survival. A 10% increase in LVEF lead to two-fold increase in the Odds for survival. LVEF upon presentation for ACS due to ULMCA occlusion is certainly dependent upon its intrinsic value before the

TABLE 5 Comparisons with previous studies.

	De Luca et al.[6]	Sakai et al.[13]	Puricel et al.[5]	Edes et al.[7]	Gutiérrez-Barrios et al.[14]	Duerig et al.
Publication date	2003	2004	2011	2018	2020	2022
Inclusion period	1990–2001	1992–2000	1995–2007	2009–2017	2005–2019	2007–2021
Nb of patients with ULMCA occlusion (TIMI ≤ 1)	20	36	16	23	46	55
% Any CPR	NA	NA	NA	52%	67.4%	43.6%
% pVAD	0%	NA	NA	13%	52.1%	32.7%
% in-hospital death	60%	55%	NA	57%	58.6%	41.8%

Abbreviations: CPR, cardiopulmonary resuscitation; pVAD, percutaneous ventricular assist device; ULMCA, unprotected left main coronary artery.

acute event which was unfortunately neither available nor provided in this analysis. Furthermore, LVEF upon presentation seems a function of the mass of hypoperfused myocardium secondary to ULMCA occlusion. Therefore, one might speculate that patients with right coronary artery (RCA) dominance and those with pre-existing right-to-left collaterals will present with less severely depressed LVEF, having less myocardium at risk. Likewise, the heart's ability to form collaterals in response to the acute should influence the preservation of left-sided systolic function. An incompletely occluded LM with residual TIMI 1 flow theoretically leads to less hypoperfused myocardium and therefore puts less myocardial mass at risk. Interestingly, Gutierrez-Barrios and colleagues found right dominance in all 46 patients included in their study on ULMCA occlusion subsequently postulating that patients with left dominance probably die before reaching the cath lab.[16] Although plausible, the precise role of coronary anatomy in the prognosis of patients with ULMCA occlusion has yet to be defined. A small registry found a trend toward decreased early mortality in patients with collateral flow, RCA dominance, and incomplete occlusion.[17] This might be further suggested by the results obtained by De Luca et al.[8] which associated the presence of collaterals (Rentrop ≥ 2) with lower in-hospital mortality.

While all centers participating in the study had access to ventricular assist devices, use was not systematic. Overall, 58% of patients received some form of mechanical support. IABP as standalone hemodynamic support was most frequently used (25% of patients). Extracorporeal membrane oxygenation and/or percutaneous ventricular assist device were used in 20% of patients. The use of hemodynamic assist device has not systematically been reported. Its use in this setting varies and ranges between 52% and 100%.[8,9,16]

Although most patients survive primary PCI, intrahospital mortality remains very high. The rate of early ST (6%) is higher than expected when compared with general ACS populations. ST causes are variable and due to several different factors such as patient characteristics (age, sex diabetes, DAPT compliance, etc.), lesion complexity (clacification, bifurcation, length, etc.), and procedural factors (lesion preparation, thrombus aspiration stent underexpansion, malapposition). Interestingly lesion predilatation was more frequent in survivors, and thrombus aspiration was less frequent. Unfortunately, information on dual antiplatelet therapy type and duration was not reliable.

In the present analysis, 42% of patients died in hospital, the majority of which were cardiac origin. An important variation in regard to mortality exists in current the literature: Homorodean et al.[13] report 30.8%, whereas De Luca et al.[8] report 58% in-hospital mortality. All other manuscripts of significance report in-hospital death rates between these two extremes.[9,16–18] These variations may be explained in part by heterogeneous inclusion criteria, and heterogeneity in treatment modalities.

Nonetheless, in-hospital mortality for ACS patients due to UMLCA occlusion or subocclusion vastly exceed the 4%–12% mortality in unselected STEMI patients observed in national registries from ESC countries.[19]

In-hospital mortality (15%) and overall mortality (47%) are high. Overall mortality at maximum follow-up was 47%. The literature reports similar 6–18 months mortality rates which vary between 44% and 63% (Table 5).[8,9,13,17] However, survival in patients discharged alive from index hospitalization is encouraging (91%). Of note, cumulative 1-year mortality in unselected STEMI patients is estimated at 10%.[14] Of 32 hospital survivors, only 9% died between discharge and maximum follow-up. All deaths occurring after hospital discharge were classified as cardiac. This finding is in line with previously described mortality rates in patients discharged alive which is reported as low as 2% and as high as 13% at maximum follow-up.[8,9,13,17]

The mortality in unselected STEMI patients from hospital discharge to 1-year follow-up has been estimated at roughly 3%–4%.[20]

5 | LIMITATIONS

There are several limitations to this analysis. First, given the retrospective design of the analysis and the retrospective collection of data in certain participating institutions, it is subject to all forms of information bias. Second, its retrospective design precluded the collection of prognostically relevant information, in particular regarding coronary anatomy with dominance and collateral flow that unfortunately could not be assessed in the present study. Third, and due to the long inclusion period, treatment of patients is affected by differences in technology and medication that had evolved during the study period.

6 | CONCLUSION

Complete ULMCA occlusion carries a high short-term mortality. Patients who survive the index hospitalization have mortality rates similar to unselected STEMI patients.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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