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An overview of end-of-life issues in a cardiology department. Is the mode of death worse in the cardiac intensive care unit?

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1 Introduction

Cardiovascular (CV) diseases are the most common causes of death and causes frequent hospital admissions.[1] The increase in life expectancy and the appearance of new treatments,[2] is changing in the clinical profile of CV disease, with a rise in chronic processes and concomitant comorbidities.[3] These changes are probably reflected in the current profile of patients admitted to cardiology departments, and in their causes of mortality.

The coronary care units emerged at the end of the 1960s,[4] with the aim of improving the care provided to patients with acute myocardial infarction. With the generalization of these units, there has been an important evolution and a great diversification of patients and diagnoses of admission. The causes of mortality in these units, as well as the treatment administered, invasive procedures or palliative interventions could differ from patients who are admitted to the conventional hospitalization ward. Most of the studies concerning the mode of death in cardiology departments are old, previous to reperfusion era[5–7] or do not address current important issues, such as end-of-life decisions regarding therapeutic support.[4,8]

Our main objective was to characterize the causes of death, the therapeutic support, and decisions on life-sustaining therapies at the end-of-life. We also aimed to determine the independent predictors associated with a higher likelihood of receiving comfort measures or a palliative intervention at the end-of-life.

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2 Methods

2.1 Data collection

We performed an observational retrospective study, including all deaths that took place in the cardiology department of an academic hospital during a 5-years period (from 1st January, 2013 to 31st December, 2017). Data were extracted from hospital administrative lists, and information related with the hospital admission and mode of death was collected from the medical electronic records or autopsy reports (when available).

Patients were classified according the place of death (intensive cardiac care unit or conventional ward). The variables reported include demographic data, patients' previous medical history, and diagnoses at admission. Mortality causes were classified as CV or non-CV, according to the previous definitions of the Standardized Data Collection for CV Trials Initiative (SCTI) and the U.S. Food and Drug Administration (FDA).[9] We made a distinction between primary (underlying disease that started the chain of events resulting in death) and intervening causes of death (other conditions that contribute to death).[9] Regarding in hospital treatment, the variables recorded included "do-not-resuscitate" orders, palliative measures/comfort medications (defined as interventions that provide immediate symptoms relief in patients close to death), and invasive life-sustaining therapies (renal replacement therapy, intra-aortic balloon pump, mechanical ventilation, or inotropes). We also differentiated between patients with a previous "do-not-resuscitate" order and unexpected deaths (those occurring in patients with on-going therapeutic efforts). Limitation of therapeutic effort was defined as the decision based on the

status and prognosis of a patient to not apply treatments or perform procedures that would prolong agony.[10]

2.2 Statistical analysis

Quantitative variables are presented as mean ± SD, or median (interquartile rank) for non-normally distributed variables. Categorical variables are presented as frequencies and percentages. Continuous quantitative variables were compared using Student's *t*-test and ANOVA for the comparison of means or the Wilcoxon rank sum in non-parametric data, and the categorical variables with the χ^2 test and the Fischer exact test. Bonferroni's correction was applied for multiple comparisons. A significance level of 0.05 (bilateral) was set for all statistical tests. Multivariate analysis included multiple logistic regression modelling techniques, for the primary endpoints. To determine which variables were entered into the final model, we used a sequential inclusion and exclusion method, with an inclusion p threshold lower than 0.05 and exclusion over than 0.1. All analyses were performed with the STATA software (Version 14.0).

This study accomplishes with the Declaration of Helsinki and was approved by the Ethics Committee of Clinical Investigation, Hospital Universitario Gregorio Marañón, Madrid, Spain.

3 Results

During the study period a total of 500 deaths were recorded in our cardiology department. Mean age was 74.2 ± 13.1 years, and 186 (37.2%) were women. The more common diagnoses at admission were heart failure 181 (36.2%) and cardiac arrest 145 (29.0%). The clinical profile according to the diagnoses of admission is depicted in Table 1. CV causes of death were found as the primary cause of mortality in 407 patients (81.4%). Non-CV causes were the leading cause of mortality in 93 patients (18.6%), and acted as an intervening cause of death in 182 (36.4%). Therefore, globally, a non-CV cause played a role in 275 patients (55.0%). Table 1 also describes the therapeutic efforts according to the diagnosis of admission. Patients with heart failure received more frequently a limitation of therapeutic effort, a less aggressive treatment, and more comfort measures compared to the rest of diagnoses of admission. Patients who were admitted for heart failure decompensation had an advanced age, presented frequent comorbidities and often had a non-cardiac cause of mortality [especially infections 41 patients (39.8%)]. Other less common causes of death included mechanical complications of acute coronary syndromes in 23 patients, pulmonary embolism in 10 patients, periprocedural complications in 6 patients, and bradycardia in 2 patients (in both cases a conservative approach was preferable due to advanced age and dementia).

Most of the fatalities occurred in the cardiac intensive care unit [354 patients (70.8%)], and those patients' clinical characteristics and mode of death were different from the ones that died in the cardiology ward (Table 2). Deaths in patients with a previous "do-not-resuscitate" order were more usual in the conventional ward compared to the cardiac intensive care unit [131 patients (89.7%) *vs.* 261 patients (73.7%), $P < 0.001$]. Comfort therapies administration was also more common in the conventional ward [121 patients (82.9%)], compared to the cardiac intensive care unit [208 patients (58.8%)], $P = 0.001$. Finally, limitation in therapeutic effort before death was also more usual in the conventional ward [121 patients (92.4%)], than in the cardiac intensive care unit [191 patients (73.2%)], $P < 0.001$.

Half of the patients admitted after presenting a resuscitated cardiac arrest died due to neurologic injuries (hypoxic-ischemic encephalopathy). Mortality after resuscitated cardiac arrest had a biphasic pattern, with an early peak in the first 24 hours due to hemodynamic instability, and a second peak over the 5th day, due to hypoxic encephalopathy (Figure 1). Table 3 shows the comparative analysis between patients with a previous "do-not-resuscitate" order and those with on-going therapy.

Treatments administered during the last 24 hours of life are depicted in Figure 2. About a quarter of patients received inotropes, antibiotics, or antiplatelet agents. A total of 40 patients had an implantable cardioverter defibrillator, but information about therapies deactivation was only registered in the medical records of 14 patients (34.2%).

The independent predictors associated with limitation of therapeutic effort, and comfort measures administrations before death are depicted in Table 4. After adjusting for clinical characteristics and comorbidities, the strongest predictors of withdrawing life-sustaining therapies were heart failure or hypoxic-ischemic encephalopathy. Death due to CV causes (except death due to pump failure) was associated with a lower probability of both a "do-not-resuscitate" order, and comfort measures administration before death.

Patients dying with heart failure presented the longest length of hospital stay (15.3 ± 29.7 days). After excluding heart failure deaths, duration of hospital admission tended to be shorter in patients who died due to a CV cause (5.6 ± 11.0 days), compared to those with a non-CV cause of death (20.4 ± 43.2 days), $P = 0.04$.

Table 1. Basal demographic characteristics, previous medical history and mortality-related factors according to admission diagnosis.

Variables	Total (*n* = 500)	Acute coronary syndromes (*n* = 115)	Cardiac arrest (*n* = 145)	Heart failure (*n* = 181)	Others* (*n* = 59)	*P*-value
Age, yrs	74.2 ± 13.1	78.1 ± 11.0	69.7 ± 13.3	73.6 ± 13.7	79.6 ± 9.6	< 0.001
Female sex	186 (37.2%)	49 (42.6%)	38 (26.2%)	68 (37.6%)	31 (52.5%)	0.002
History of ischemic heart disease	162 (32.5%)	33 (28.9%)	45 (31.0%)	67 (37.0%)	17 (28.8%)	0.42
History of valvular heart disease	146 (29.4%)	23 (20.2%)	18 (12.5%)	84 (46.9%)	21 (35.6%)	< 0.001
History of heart failure	183 (36.8%)	16 (14.0%)	26 (18.0%)	113 (62.4%)	28 (47.5%)	< 0.001
Left ventricular ejection fraction	39.3% ± 17.3%	35.2% ± 15.3%	39.5% ± 16.7%	38.1% ± 17.8%	49.8% ± 16.8%	< 0.001
Atrial fibrillation	160 (32.2%)	24 (21.1%)	33 (23.1%)	83 (45.9%)	20 (33.9%)	< 0.001
Chronic obstructive pulmonary disease	116 (23.4%)	19 (16.8%)	40 (28.0%)	48 (26.5%)	9 (15.3%)	0.048
Chronic kidney disease	182 (36.7%)	34 (30.1%)	34 (23.8%)	91 (50.3%)	23 (39.0%)	< 0.001
Peripheral arterial disease	88 (17.7%)	16 (14.2%)	23 (16.1%)	38 (21.0%)	11 (18.6%)	0.455
Stroke with sequels	52 (10.5%)	11 (9.7%)	11 (7.7%)	19 (10.5%)	11 (18.6%)	0.183
Place of death						
Conventional ward	146 (29.2%)	77 (67.9%)	142 (97.9%)	89 (49.2%)	46 (78.0%)	< 0.001
Coronary unit	354 (70.8%)	38 (33.0%)	3 (2.1%)	92 (50.8%)	13 (22.0%)	
Length of hospital stay, days	13.5 ± 43.3	8.6 ± 15.1	12.2 ± 68.4	19.7 ± 34.7	7.6 ± 9.7	0.093
Death from cardiac causes (*n* = 407)						
Death from cardiac causes	407 (81.4%)	109 (94.8%)	82 (56.6%)	167 (92.3%)	49 (83.1%)	< 0.001
"Pump failure"	267 (65.8%)	60 (55.1%)	47 (57.3%)	138 (83.1%)	22 (44.9%)	
Severe coronary ischemia	8 (2.0%)	7 (6.4%)	1 (1.2%)	-	-	< 0.001
Sudden death	90 (22.2%)	21 (19.3%)	26 (31.7%)	27 (16.3%)	16 (32.7%)	
Non-cardiac causes as primary cause of death or significant contributors (*n* = 275)**						
Septic shock/infection	77 (28%)	13 (35.1%)	6 (6.0%)	41 (39.8%)	17 (48.6%)	
Acute renal failure	47 (17.1%)	9 (24.3%)	5 (5.0%)	28 (27.2%)	5 (14.3%)	
Brain death/Hypoxic-ischaemic encephalopathy	79 (28.3%)	0	74 (74.0%)	1 (1.0%)	4 (11.4%)	< 0.001
Stroke	17 (6.2%)	4 (10.8%)	3 (3.0%)	5 (4.9%)	5 (14.3%)	
Respiratory	23 (8.4%)	3 (8.1%)	8 (8.0%)	11 (10.7%)	1 (2.9%)	
Gastrointestinal	17 (6.2%)	5 (13.5%)	2 (2.0%)	7 (6.8%)	3 (8.6%)	
Patients with a "do-not-resuscitate" order	392 (78.4%)	80 (69.6%)	114 (78.6%)	158 (87.3%)	40 (67.8%)	0.001
Comfort measures	329 (65.8%)	68 (59.1%)	91 (62.8%)	140 (77.4%)	30 (50.9%)	0.001
Vasoactive drugs during hospital admission	387 (77.4%)	84 (73.0%)	138 (95.2%)	122 (67.4%)	43 (72.9%)	< 0.001
Discontinuation of cardiac implantable defibrillator therapy (in defibrillator carriers)	14 (34.2%)	2 (50.0%)	0	9 (33.3%)	3 (60.0%)	0.209
Mechanical ventilation	268 (53.6%)	50 (43.5%)	144 (99.3%)	47 (26.0%)	27 (45.8%)	< 0.001
Non-invasive mechanical ventilation	85 (17.0%)	18 (15.7%)	6 (4.1%)	53 (29.3%)	8 (13.8%)	< 0.001
Inotropes during admission	387 (77.4%)	84 (73.0%)	138 (95.2%)	122 (67.4%)	43 (72.3%)	< 0.001
Mechanical circulatory support	91 (18.2%)	37 (32.2%)	27 (18.6%)	20 (11.1%)	7 (11.9%)	< 0.001
Temporary pacemaker	43 (8.6%)	12 (10.4%)	6 (4.1%)	7 (3.9%)	18 (30.5%)	< 0.001
Coronary angiography	215 (43.0%)	81 (70.4%)	78 (53.8%)	39 (21.6%)	17 (28.8%)	< 0.001
Renal replacement therapy	48 (9.6%)	8 (7.0%)	10 (6.9%)	24 (13.3%)	6 (10.2%)	0.179
Therapeutic hypothermia	59 (11.8%)	0	56 (38.9%)	2 (1.1%)	1 (1.7%)	< 0.001
Opioids during admission	372 (74.9%)	76 (66.1%)	110 (76.9%)	155 (86.1%)	31 (52.5%)	< 0.001
Place of death						
Conventional ward	146 (29.2%)	77 (67.9%)	3 (2.1%)	89 (49.2%)	46 (78.0%)	< 0.001
Coronary unit	354 (70.8%)	38 (33.0%)	142 (97.9%)	92 (50.8%)	13 (22.0%)	
Length of hospital stay, days	13.5 ± 43.3	8.6 ± 15.1	12.2 ± 68.4	19.7 ± 34.7	7.6 ± 9.7	0.093
Number of days on mechanical ventilation	4.3 ± 6.4	4.6 ± 7.7	3.8 ± 4.1	6.0 ± 10.0	2.6 ± 2.5	0.158

Data are presented as means ± SD or *n* (%). *Bradycardia/atrio-ventricular block 20 patients, myocarditis 1 patient, pulmonary embolism 10 patients, septic shock 7 patients, cardiac tamponade 2 patients, elective interventional procedures 11 patients. **Non-CV causes played a role in 275 patients (55.0%), non-CV causes were the leading cause of mortality in 93 patients (18.6%), and acted as an intervening cause of death in 182 (36.4%). CV: cardiovascular.

Table 2. Basal demographic characteristics, previous medical history and mortality-related factors according to the place of death.

Variables	Cardiac intensive care unit	Conventional ward	*P*-value
Age, yrs	72.4 ± 13.5	78.6 ± 10.7	< 0.001
Female sex	127 (35.9%)	59 (40.4%)	0.342
Hypertension	250 (71.2%)	120 (82.2%)	0.009
Diabetes	129 (36.8%)	61 (41.8%)	0.547
Functional Class > II	50 (27.2%)	46 (51.7%)	< 0.001
History of ischemic heart disease	102 (28.9%)	60 (41.1%)	0.009
Previous valvular heart disease	74 (21.1%)	72 (49.7%)	< 0.001
Previous heart failure admissions	96 (27.3%)	87 (59.6%)	< 0.001
Left ventricular ejection fraction	39.1% ± 17.3%	39.8% ± 17.4%	0.7243
Atrial Fibrillation	86 (24.5%)	74 (50.7%)	< 0.001
Cardiac devices			
Conventional pacemaker	21 (6.0%)	25 (17.1%)	< 0.001
Implantable cardioverter defibrillator	20 (5.7%)	14 (9.6%)	
Chronic kidney disease	103 (29.4%)	79 (54.1%)	< 0.001
Peripheral arterial disease	61 (17.4%)	27 (18.5%)	0.77
Stroke with sequels	33 (9.4%)	19 (13.1%)	0.261
Mild to moderate cognitive decline	23 (6.6%)	14 (9.6%)	0.262
Most common diagnoses at admission			
Acute coronary syndrome	77 (21.8%)	38 (26.0%)	< 0.001
Cardiac arrest	142 (40.1%)	3 (2.1%)	
Heart failure	89 (25.1%)	92 (63.0%)	
Death from cardiac causes (n = 407)			
Death from cardiac causes	269 (76.0%)	138 (94.5%)	< 0.001
"Pump failure"/Cardiogenic shock	158 (59.0%)	109 (79.0%)	
Severe coronary ischemia	5 (1.9%)	3 (2.2%)	< 0.001
Sudden cardiac death	69 (25.8%)	21 (15.2%)	
Death from non-cardiac causes (n = 275)			
Septic shock/infection	48 (13.6%)	29 (19.9%)	
Acute renal failure	23 (6.5%)	24 (16.4%)	
Brain death/Hypoxic-ischaemic encephalopathy	78 (22.1%)	1 (0.7%)	< 0.001
Stroke	11 (3.1%)	6 (4.1%)	
Respiratory	18 (5.1%)	5 (3.4%)	
Gastrointestinal	12 (3.4%)	5 (3.4%)	
Patients with a "do-not-resuscitate" order	261 (73.7%)	131 (89.7%)	< 0.001
Comfort measures	208 (58.8%)	121 (82.9%)	< 0.001
Vasoactive drugs during hospital admission	319 (90.1%)	68 (46.6%)	< 0.001
Discontinuation of cardiac implantable defibrillator therapy (in defibrillator carriers)	7 (36.8%)	12 (75.0%)	0.584
Mechanical ventilation	253 (71.5%)	15 (10.3%)	< 0.001
Non-invasive mechanical ventilation	59 (16.7%)	26 (17.8%)	0.794
Mechanical circulatory support	88 (24.9%)	3 (2.1%)	< 0.001
Temporary pacemaker	37 (10.5%)	6 (4.1%)	0.014
Coronary angiography	184 (52.0%)	31 (21.1%)	< 0.001
Renal replacement therapy	42 (11.9%)	6 (4.1%)	0.007
Therapeutic hypothermia	57 (16.2%)	2 (1.4%)	< 0.001
Opioids during admission	247 (70.4%)	125 (85.6%)	< 0.001
Length of hospital stay, days	10.0 ± 45.3	21.9 ± 36.7	0.005

Data are presented as means ± SD or n (%).

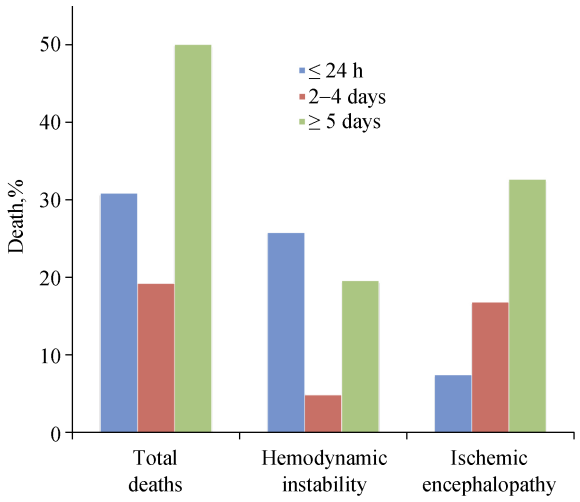

Figure 1. Mortality during hospital admission in patients admitted after a resuscitated cardiac arrest. The bar height represents the percentage of patients admitted after a resuscitated cardiac arrest who died from each cause throughout the hospital admission (n = 145). Hospital mortality has been divided in three periods: ≤ 24 h, 2–4 days, and ≥ 5 days.

4 Discussion

Our study shows that more than three quarters of the deaths occurring in a cardiology department occur in patients with a prior "do-not-resuscitate" order. "Pump failure" is the most common cause of death, but non-CV causes are also frequent. Limitation of therapeutic effort is more frequent in patients admitted with heart failure than in those admitted due to cardiac arrest or acute coronary syndrome. Heart failure patients also received more comfort measures before death than those hospitalized for other reasons. Patients who died in the cardiac intensive care unit received less comfort measures/palliative interventions before death than those admitted to the conventional ward.

As it was expected, patients with a "do-not-resuscitate" order were older, and presented more associated CV diseases and comorbidities. It is remarkable that dying due to a CV cause was associated with a lower rate of therapeutic withdrawal, compared to a non-CV cause. This observation has also been found in previous studies.[11,12] A proposed explanation is that patients who die due to a CV condition are more likely to present hemodynamic instability leading to a rapid death, and consequently, a shorter length of hospital stay.[12] By contrast, non-CV deaths are often related to intractable multiorgan failure,[12,13] and can be easily predicted.

We have found that nearly 90% deaths in the conventional ward were expected (occurred after withholding a treatment procedure due to perceived futility) and consequently, therapeutic efforts had been limited before death. A similar proportion has been found in a previous study performed in an internal medicine ward.[14] In our cardiac intensive care unit, about three quarters of patients who died had a prior "do-not-resuscitate" order. This proportion contrasts with the significantly lower percentage of patients who received a palliative approach and comfort measures (interventions aimed at providing an immediate relief of symptoms), which did not reach 60% of deaths at the cardiac intensive care unit. The limitation of therapeutic effort in the intensive care unit is still a pending issue,[15] and palliative care is frequently not incorporated into daily clinical practice despite its proven efficacy.[16,17] It has been estimated that about one in five deaths documented in the United States may occur in a critical care bed,[15] but in our cardiology department such proportion was higher (nearly three quarters).

Decisions regarding withholding/withdrawing life-sustaining therapies take into account several factors and vary widely between geographical areas.[18] In this sense, prognostic information is crucial,[15] and this fact was consistent with the findings of our study, as the two strongest predictors regarding limitation of therapeutic effort were dying due to hypoxic encephalopathy and terminal heart failure. As we have noted in this registry, admissions after presenting a resuscitated cardiac arrest accounted for approximately one third of the deaths, and in this group hypoxic encephalopathy was the main reason of death. By contrast, although cognitive impairment has traditionally been an independent predictor of therapeutic effort limitation,[19] this was not the case in our study. Patients who died in our department were mainly male. This fact could be explained by the higher prevalence of CV disease in men,[20] and also a greater frailty in women;[21,22] who would be probably referred to other wards, such as internal medicine or geriatrics.

Regarding patients who were admitted due to heart failure, death due to "pump failure" or terminal heart failure was the most common cause of death, as it has been previously described.[2,23–25] These patients had common comorbidities and received lesser aggressive treatments at the end of life than patients who died of other causes or had different diagnoses at admission.

There seems to be field for improvement. For example, in carriers of implantable cardioverter defibrillators, a written record of deactivation was only found in a minority of cases, despite the previous decision to limit the therapeutic effort. This situation has also been described in a previous experience.[26] In this sense, it is important to involve in an early phase all the professionals who take care of these

Table 3. Basal demographic characteristics, previous medical history and mortality-related factors according to therapeutic effort.

Variables	Patients with a "do-not-resuscitate" order (*n* = 392)	Patients with on-going therapeutic efforts (*n* = 108)	*P*-value
Age, yrs	75.1 ± 13.5	70.9 ± 12.8	0.0029
Female sex	148 (37.8%)	38 (35.2%)	0.624
Hypertension	303 (77.3%)	67 (63.8%)	0.008
Diabetes	157 (40.1%)	33 (31.4%)	0.128
New York Heart Association Functional Class > II	84 (38.9%)	12 (21.1%)	0.002
History of ischemic heart disease	136 (34.7%)	26 (24.3%)	0.048
Previous valvular heart disease	130 (33.3%)	16 (15.1%)	< 0.001
Previous heart failure admissions	160 (40.8%)	23 (21.7%)	< 0.001
Left ventricular ejection fraction	39.2% ± 17.3%	40.2% ± 17.6%	0.634
Atrial Fibrillation	139 (35.6%)	21 (19.8%)	0.002
Cardiac devices			
Conventional pacemaker	39 (10.0%)	7 (6.6%)	0.054
Implantable cardioverter defibrillator	31 (7.9%)	2 (2.8%)	
Chronic kidney disease	161 (41.1%)	21 (20.2%)	< 0.001
Peripheral arterial disease	73 (18.6%)	15 (14.4%)	0.387
Stroke with sequels	45 (11.5%)	7 (6.7%)	0.207
Mild to moderate cognitive decline	32 (8.2%)	5 (4.8%)	0.299
Most common diagnoses at admission			
Acute coronary syndrome	80 (20.4%)	35 (32.4%)	0.001
Cardiac arrest	114 (29.1%)	31 (28.7%)	
Heart failure	158 (40.3%)	23 (21.3%)	
Death from cardiac causes (*n* = 407)			
Death from cardiac causes	303 (77.3%)	104 (96.3%)	< 0.001
Pump failure/Cardiogenic shock	252 (64.3%)	15 (13.9%)	< 0.001
Severe coronary ischemia	7 (1.8%)	1 (0.9%)	0.502
Sudden cardiac death	21 (5.4%)	66 (61.1%)	< 0.001
Death from non-cardiac causes (*n* = 275)*			
Septic shock/infection	70 (17.9%)	7 (6.5%)	
Acute renal failure	45 (11.5%)	2 (1.9%)	
Brain death/Hypoxic-ischaemic encephalopathy	77 (19.7%)	2 (1.9%)	< 0.001
Stroke	15 (3.8%)	2 (1.9%)	
Respiratory	18 (4.6%)	5 (4.6%)	
Gastrointestinal	12 (3.1%)	2 (0.5%)	
Comfort measures	326 (83.2%)	3 (2.8%)	< 0.001
Vasoactive drugs during hospital admission	288 (73.5%)	99 (91.7%)	< 0.001
Discontinuation of cardiac implantable defibrillator therapy (in defibrillator carriers)	12 (31.6%)	2 (66.7%)	0.232
Mechanical ventilation	177 (45.2%)	91 (84.3%)	< 0.001
Non-invasive mechanical ventilation	81 (20.7%)	4 (3.7%)	< 0.001
Mechanical circulatory support	70 (17.9%)	21 (19.4%)	0.676
Temporary pacemaker	30 (7.7%)	13 (12.0%)	0.166
Coronary angiography	160 (40.8%)	55 (50.9%)	0.061
Renal replacement therapy	42 (10.7%)	6 (5.6%)	0.139
Therapeutic hypothermia	55 (14.1%)	3 (3.7%)	0.002
Opioids during admission	342 (87.9%)	30 (27.8%)	< 0.001
Place of death			
Conventional ward	131 (33.4%)	15 (13.9%)	< 0.001
Coronary unit	261 (66.6%)	93 (86.1%)	
Length of hospital stay , days	15.8 ± 48.3	5.3 ± 11.4	0.0264

Data are presented as means ± SD or *n* (%). *Non-CV causes played a role in 275 patients (55.0%), non-CV causes were the leading cause of mortality in 93 patients (18.6%), and acted as an intervening cause of death in 182 (36.4%). CV: cardiovascular.

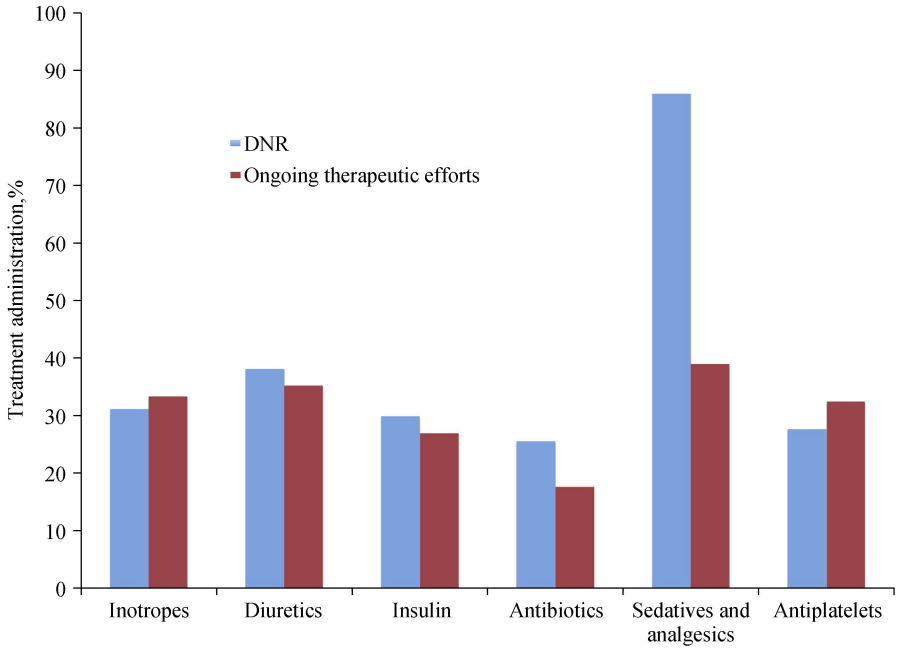

Figure 2. Rate of treatment administration in the last 24 h of life. DNR: do-not-resuscitate.

Table 4. Independent predictors of limitation of therapeutic effort and administration of comfort treatments before death.

	OR (95% CI)	*P*-value
Limitation of therapeutic effort		
Age	1.02 (1.01–1.05)	0.044
Chronic kidney disease	2.1 (1.01–4.31)	0.048
Previous ischemic heart disease	2.13 (1.01–4.46)	0.046
Diagnosis of heart failure at admission	2.60 (1.34–5.04)	0.005
Death due to CV causes	0.10 (0.03–0.32)	< 0.001
Death due to pump failure	11.5 (5.01–26.56)	< 0.001
Death due to sudden death	0.23 (0.10–0.55)	0.001
Death due to brain death/Hypoxic-ischaemic encephalopathy	11.90 (2.32–61.00)	0.003
Comfort measures before death		
Age	1.01 (1.009–1.04)	0.005
Chronic kidney disease	2.19 (1.38–3.46)	0.001
Diagnosis of heart failure	3.52 (2.07–6.00)	< 0.001
Death due to brain death/Hypoxic-ischaemic encephalopathy	5.45 (2.53–11.77)	< 0.001
Death due to pump failure	24.61 (13.83–43.78)	< 0.001

CI: confidence interval; OR: odds ratio.

patients.[26] In addition, there was a very high prescription of medications that can be considered futile in patients with a limited life expectancy and a near death.

4.1 Limitations

This study has some limitations. The presented data correspond to the experience of a single center, and there could be differences with other cardiology departments. In addition, our study analyses only the deaths during admission and no information was collected from other patients. However, our study provides detailed information about the causes of mortality, end-of-life management, and suggests opportunities for future improvement, especially in patients with end-stage heart disease.

4.2 Conclusions

More than three quarters of the deaths occurring in a cardiology department occurs in patients with a previous "do-not-resuscitate" order, but not all patients receive comfort or palliative measures before death. We have found a

high prescription of life-sustaining therapies the last 24 hours of life. Heart failure was the most frequent diagnosis and the limitation of therapeutic effort was more common in this group than in the rest of diagnoses. Patients who died in the cardiac intensive care unit received less palliative measures before death.

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