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Clinical paper

Outcome, compliance with inclusion criteria and cost of extracorporeal cardiopulmonary resuscitation (ECPR) in out-of-hospital cardiac arrest: A retrospective cohort study

Dennis De Blick [a,b,*], Bert Peeters [a,b], Philip Verdonck [a,b], Erwin Snijders [a,b], Karen Peeters [a,b], Inez Rodrigus [a,c], Jan Coveliers [a,c], Rudi De Paep [a,d], Philippe G. Jorens [a,d], Hein Heidbuchel [a,e], Gerdy Debeuckelaere [a,f], Koenraad G. Monsieurs [a,b]

[a] Faculty of Medicine and Health Sciences, University of Antwerp, Wilrijk, Belgium
[b] Emergency Department, Antwerp University Hospital, Edegem, Belgium
[c] Department of Cardiac Surgery, Antwerp University Hospital, Edegem, Belgium
[d] Intensive Care Department, Antwerp University Hospital, Edegem, Belgium
[e] Department of Cardiology, Antwerp University Hospital, Edegem, Belgium
[f] Perfusion Department, Antwerp University Hospital, Edegem, Belgium

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ABSTRACT

Introduction: The primary aim was to describe the outcome, the compliance with inclusion criteria and the characteristics of patients who underwent extracorporeal cardiopulmonary resuscitation (ECPR) for out-of-hospital cardiac arrest (OHCA). The secondary aim was to calculate the cost of ECPR for the patients and the public Belgian healthcare system.

Methods: Single-centre retrospective cohort study in Antwerp University Hospital. We included all patients who underwent ECPR for OHCA from 2018 to 2020. Medical records were assessed to determine the clinical outcome and invoices were assessed to calculate the charged fees. We collected all relevant cost components at the most detailed level (micro costing technique).

Results: Sixty-five patients who received ECPR for OHCA were included. Thirty-eight patients (58%) died within one week after ECPR initiation. After one year, twelve patients (18.5%) were still alive of which ten (15.4%) had a good neurological outcome (Cerebral Performance Category (CPC) 1 or 2). Forty-nine patients (75.4%) met the ECPR inclusion criteria. A total of 2,552,498.34 euro was charged. The patients and the public Belgian healthcare system contributed to a 255,250 euro cost for each survivor after one year with good neurological outcome.

Conclusion: Our analysis highlights the complex interplay between clinical efficacy and financial implications in the utilization of ECPR. While ECPR demonstrates potential in improving survival rates and neurological outcomes among cardiac arrest patients, its adoption presents substantial economic challenges. Inappropriate patient selection may lead to significant increases in resource utilisation without improved outcome.

Introduction

Sudden cardiac arrest is the third leading cause of death in Europe.[1–4] Survival from out-of-hospital cardiac arrest (OHCA) has remained low for the past decades and depends largely on early and high-quality cardiopulmonary resuscitation (CPR).[2–4] Extracorporeal cardiopulmonary resuscitation (ECPR) refers to the implementation of veno-arterial Extracorporeal Life Support (ECLS) during cardiac arrest. Several observational cohort studies and four randomised controlled trials assessed ECPR to provide cardiopulmonary support in patients who did not have prompt Return of Spontaneous Circulation (ROSC) with conventional CPR.[1,5–10] Most of these studies suggested increased survival in patients with refractory cardiac arrest, especially in patients presenting with a shockable rhythm. Two recent *meta*-analyses found that there is no high-quality evidence supporting the superiority of ECPR over conventional CPR in terms of long-term survival and neurological outcomes in OHCA patients.[11–12] There remains uncertainty about the efficacy of ECPR in some subsets of patients and its use raises moral

* Corresponding author at: Emergency Department, Antwerp University Hospital, Drie Eikenlaan 655, Edegem 2650, Belgium.
E-mail address: dennis.deblick@uza.be (D. De Blick).

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dilemmas. Applying advanced life-sustaining treatments to poorly selected patients with poor long-term prognosis, high comorbidity and poor pre-arrest quality of life may lead to futile and inappropriate care.[13] Furthermore, there is a constant challenge to maximise health benefits with the resources available, mandating the assessment of the cost-effectiveness of new therapies.[14–15] There is a need to critically evaluate whether escalation to ECPR is appropriate and which patients would benefit most.

The primary aim of the current study was to describe the outcome, the compliance with inclusion criteria and the characteristics of patients

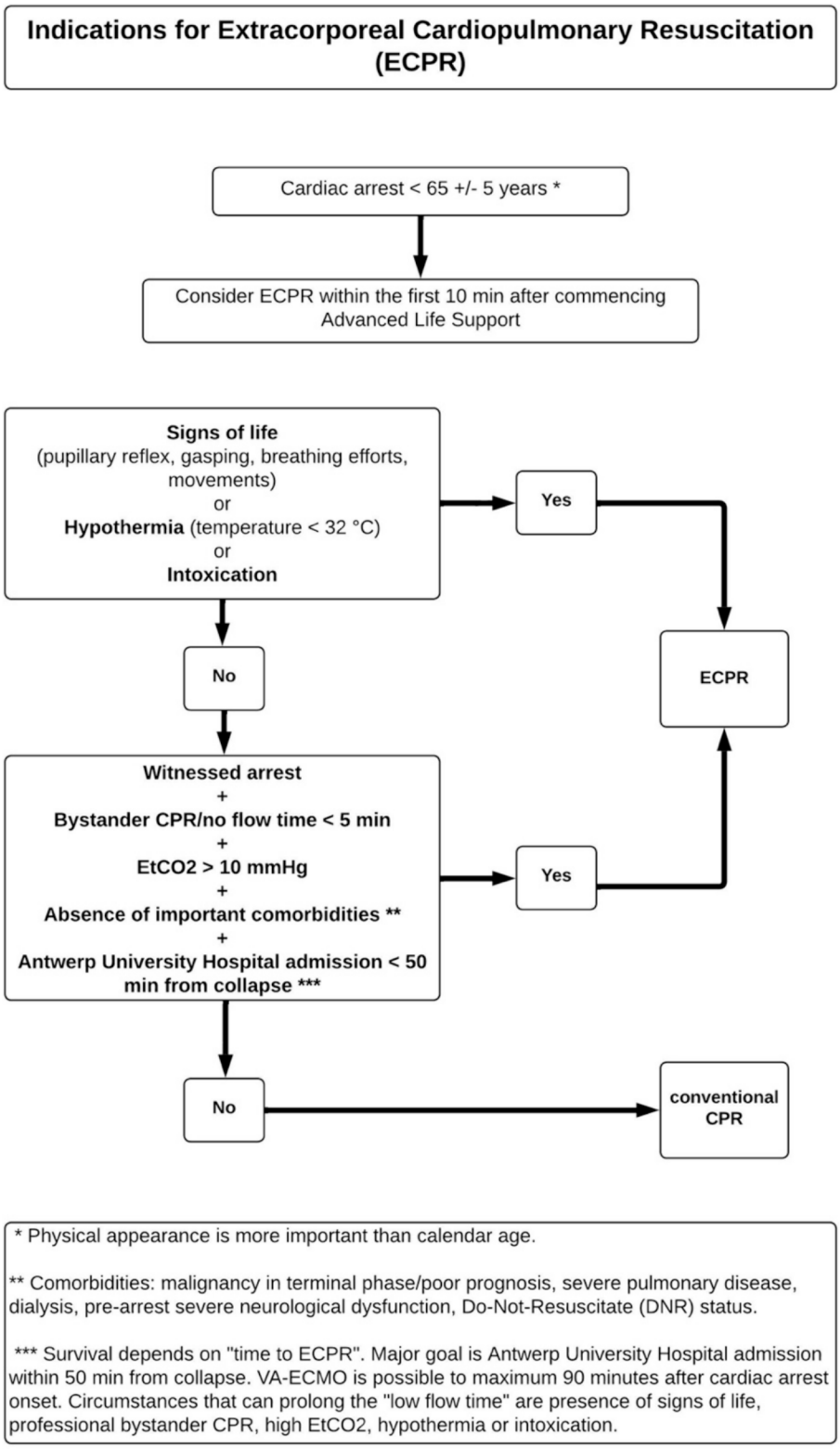

Fig. 1. Inclusion criteria for Extracorporeal Cardiopulmonary Resuscitation (ECPR) used by the emergency department of the Antwerp University Hospital from 2018 to 2020. These inclusion criteria were derived by the former Extracorporeal Life Support Organization (ELSO) guidelines of the year 2017. CPR: Cardiopulmonary Resuscitation; EtCO2: End-tidal carbon dioxide; VA-ECMO: Veno-Arterial Extracorporeal Membrane Oxygenation.

who underwent ECPR for OHCA. The secondary aim of this study was to conduct an exploratory cost assessment to gain insight into the cost related to ECPR for OHCA patients and the public Belgian healthcare system.

Methods

Study design

This is a single-centre retrospective cohort study. We included all patients who were admitted to the emergency department (ED) of Antwerp University Hospital from 2018 to 2020 and who received ECPR therapy for OHCA. Antwerp University Hospital is a tertiary care hospital with 24/7 cardiosurgical and coronary intervention capacity. The emergency medical services pre-alert the ED in case of a refractory OHCA that meets our inclusion criteria for ECPR (Fig. 1). These inclusion criteria were derived by the former Extracorporeal Life Support Organization (ELSO) guidelines.[16] An emergency physician leads a multidisciplinary ECPR team consisting of a conventional cardiac arrest team (three emergency nurses, an anaesthesiologist, an emergency physician dedicated to emergency ultrasound and a paramedic dedicated to chest compressions) and a procedure team (a cardiac surgeon, an emergency physician, a perfusionist and two operating room nurses).

Medical records were assessed to determine patient demographics, information concerning the cardiac arrest (witnessed arrest, signs of life, bystander CPR, initial rhythm, "no flow time", "low flow time" and "time to flow"), duration of ECPR, duration of hospital stay and outcome. Data were collected using the revised Utstein-style definitions.[17] The patients' personal information was anonymised. In this study, we used the bottom up and micro costing method to determine the medical expenses.[18–20] This means that we collected all relevant cost components at the most detailed level based on the Belgian official reimbursement schemes. A list of billing codes with all registered healthcare consumption per patient was obtained from the finance department of the hospital. Registered healthcare consumption included information on aspects of the duration of Intensive Care Unit (ICU) stay, hospital nursing days, imaging tests, laboratory tests, blood products, surgical procedures and direct ECPR related cost (cannulas, placement and maintenance of the ECLS device, etc.). All billing codes were classified in categories and irrelevant codes (e.g. dummy codes without price) were excluded from the cost analysis, leaving 1085 different billing codes for inclusion and analysis. The following billing code categories were identified (in alphabetical order): anaesthesiology, blood products, direct cost of ECPR, functional examinations, honoraria, imaging tests, interventional cardiology, laboratory tests, medical equipment, medication, microbiology cost, nursing, renal replacement therapy and surgery. We calculated the cost components for each of the different billing code categories. This cost evaluation was performed from the perspective of the patient and the public Belgian healthcare system. We calculated the total cost billed to each individual patient, the mean cost per patient, the total cost of the cohort and the cost reimbursed by the public Belgian healthcare system. The public Belgian healthcare system is based on solidarity. Therefore, the whole community is taxed financially in order to provide health insurance for all its citizens and funding to pay for the majority of medical expenses. The patient's personal contribution to the total billed cost is therefore usually limited. Cost covered by the hospital were not included in the analysis because these expenses were not billed to the patients and the public Belgian healthcare system.

Outcome measures

The primary aim was to describe the outcome, the compliance with inclusion criteria and the characteristics of patients who underwent ECPR for OHCA. The secondary aim was an exploratory cost study of the medical expenses for the patients and for the public Belgian healthcare system.

The duration of extracorporeal life support

The duration of ECLS was determined by collecting start and stop dates of the ECLS therapy. If the patient had died, the date of death was used as the stop date. If ECLS was removed and had to be readministered because of clinical deterioration, the multiple ECLS runs were seen as one long ECLS run, and the duration times of the multiple runs were added up. All cost concerning the maintenance and the re-administration of ECLS were covered by the hospital and did not incur any additional cost for the patient or the public Belgian healthcare system.

Statistical analysis

SPSS® 29 (The International Business Machines Corporation (IBM), US) was used for the statistical analysis. Continuous data are presented as mean with standard deviation (SD); categoric variables (including missing data) are reported as percentages. There was no loss to follow-up. Analysis of the survival distributions was performed using the Kaplan-Meier method. A log rank test was run to determine if there were differences in the survival distribution for compliance with the ECPR inclusion criteria.

Ethics Committee approval

According to the policy of the Ethics Committee of Antwerp University Hospital, approval is not required for the retrospective analysis of data registered routinely as part of the clinical process.

Results

Patient population

Patient characteristics

During the study period, 65 patients were treated with ECPR for OHCA. The mean age was 50 years (Standard Deviation (SD) 13.9). Two patients (3 %) were under the age of 18 years and fifteen patients (23 %) were female. Patient demographics and baseline characteristics are provided in Table 1. Comorbidities included the presence of one (or more) of the following: arterial hypertension, hypercholesterolaemia, diabetes, obesity (BMI $>$ 30), obstructive sleep apnea, active cardiovascular disease, active pulmonary disease, active liver disease, active oncological disease, and active auto-immune disease.

In 91 % of cases the OHCA was witnessed (Table 1). Eighty-one percent received bystander CPR and 48 % showed at least one sign of life (gasping, breathing, movement, coughing and/or pupillary light reflex) in the prehospital setting. Fifty-one patients (78.5 %) had both a witnessed arrest and received bystander CPR. The two most frequent initial rhythms prehospital were ventricular fibrillation (VF) (43.1 %) and pulseless electrical activity (PEA) (30.8 %). In our total patient cohort, the mean "no flow time" was 2.3 min (SD 3.7). The mean "low flow time" was 66.1 min (SD 22.3) and the mean "time to flow" was 70.3 min (SD 21.0). The mean duration of ECLS therapy was 6 days (SD 6). No patients underwent a secondary placement of ECLS after its removal.

In 2018, 53 % of patients (n = 9) met our ECPR inclusion criteria. In 2019 and 2020, 85 % (n = 28) and 80 % (n = 12) met the ECPR inclusion criteria, respectively. In total, 49 patients (75.4 %) met the ECPR inclusion criteria. Further details and subgroup analyses per year can be found in Table 2.

Patient outcome

Of the 65 patients, 38 (58 %) died within one week. Seventeen patients (26.2 %) were alive after one month and 14 patients (21.5 %)

Table 1
Out-of-hospital cardiac arrest circumstances & outcome.

		Outcome after one year						Total	
		One-year survival		Good neurological outcome		Bad neurological outcome			
		Count	%	Count	%	Count	%	Count	%
Total		12	18.5	10	15.4	55	84.6	65	100
Male gender		8	66.7	7	70.0	43	78.2	50	76.9
Age (years), mean (SD)		54.0 (14.5)		51.4 (10.3)		50.1 (14.6)		50.3 (13.9)	
Comorbidities present	Yes	11	91.7	9	90.0	26	47.3	35	53.8
Witnessed arrest	Yes	12	100	10	100	49	89.1	59	90.8
	Unknown	0	0.0	0	0.0	1	1.8	1	1.5
Bystander CPR	Yes	11	91.7	9	90.0	44	80	53	81.5
	Unknown	0	0.0	0	0.0	1	1.8	1	1.5
Initial rhythm prehospital	Asystole	1	8.3	1	10.0	11	20.0	12	18.5
	PEA	5	41.7	3	30.0	17	30.9	20	30.8
	VF	5	41.7	5	50.0	23	41.8	28	43.1
	pVT	1	8.3	1	10.0	3	5.5	4	6.2
	Unknown	0	5.9	0	0.0	1	1.8	1	1.5
Signs of life	Yes	7	58.3	5	50.0	26	47.3	31	47.7
	Unknown	2	16.7	2	20.0	2	3.6	4	6.2
Compliance with ECPR criteria	Yes	10	83.3	8	80.0	41	74.5	49	75.4
	Unknown	1	8.3	1	10.0	2	3.6	3	4.6

SD: Standard Deviation; CPR: cardiopulmonary resuscitation; PEA: pulseless electrical activity; VF: ventricular fibrillation; pVT: pulseless ventricular tachycardia; Good neurological outcome = Cerebral Performance Category (CPC) 1 or 2; Bad neurological outcome = CPC 3,4 or 5.

Table 2
Flow times & compliance with ECPR criteria per year.

		Year			Total
		2018	2019	2020	
No Flow Time (min)	Mean (SD)	3.5 (4.8)	2.5 (3.7)	0.5 (0.8)	2.3 (3.7)
	Min.	0.0	0.0	0.0	0.0
	Max.	17.0	15.0	2.0	17.0
Low Flow Time (min)	Mean (SD)	60.6 (21.0)	74.3 (20.2)	53.7 (21.9)	66.1 (22.3)
	Min.	13.0	50.0	10.0	10.0
	Max.	86.0	142.0	88.0	142.0
Time To Flow (min)	Mean (SD)	66.8 (18.6)	76.7 (21.0)	58.6 (17.9)	70.3 (21.0)
	Min.	32.0	51.0	37.0	32.0
	Max.	92.0	142.0	88.0	142.0
Compliance with ECPR criteria (N)	Yes	9 (52.9 %)	28 (84.8 %)	12 (80.0 %)	49 (75.4 %)
	Unknown	3 (17.6 %)	0 (0.0 %)	0 (0.0 %)	3 (4.6 %)

Time in minutes; Max.: Maximum time; Min.: Minimum time; SD: Standard Deviation; N: number of patients with percentage of total population.

survived to hospital discharge. After one year, 12 patients (18.5 %) were still alive of which ten (15.4 %) had a good neurological outcome, defined by a Cerebral Performance Category (CPC) of 1 or 2. All patients who survived after one year with a good neurological outcome (n = 10) had a witnessed arrest and 92 % had received bystander CPR. Eight of these patients (80 %) met the ECPR inclusion criteria. Their maximum time from collapse to the start of ECPR never exceeded 90 min, complying with our ECPR protocol. If we only include patients who met all the ECPR inclusion criteria, then the one-year survival rate would increase to 20.4 % (n = 10/49) and 16.3 % (n = 8/49) would have a good neurological outcome (CPC 1 or 2). One patient did not meet the ECPR inclusion criteria but survived after one year with a good neurological outcome. Further details and subgroup analyses are presented in Table 1. Fig. 2 shows the survival distribution of patients with a good neurological outcome after one year, comparing for compliance with the ECPR inclusion criteria. We can observe that the cumulative survival proportion appears to be higher in the group of patients who met the ECPR inclusion criteria. The survival distributions were statistically significantly different, $\chi^{22} = 6.147$, $p < 0.046$. Implying that patients receiving ECPR for OHCA, who meet the ECPR inclusion criteria, had a higher survival after one year with a good neurological outcome.

Medical expenses

A total of 2,552,498.34 euro was charged by the hospital for the total 65 patients. Approximately 60 % of this total cost was reimbursed by the public Belgian healthcare system, whereas only 3.6 % had to be covered by the patients' personal expenses. The remaining 26.4 % of the total cost was reimbursed by hospital governmental subsidy and by additional patient private insurance if present. The lowest and highest charged fees per patient were 5,714.29 and 358,722.91 euro respectively. The average charged fee was 39,269.21 euro (SD 50,993.40). To assess the cost of a live saved, we divided the total cost between the patients who were alive after one year. Hence to save those 12 patients, a cost of 212,708.19 euro per patient needs to be compensated. From these 12 patients, only 10 were alive after one year with a good neurological outcome (CPC 1 or 2). This means a cost of 255,249.83 euro for each patient treated by ECPR and with a good neurological outcome after one year.

If we only included patients who met the ECPR inclusion criteria, a total of 1,924,299.26 euro was charged to 49 patients. If we divide this new sum among the patients that survived after one year with good neurological outcome (n = 8/49), then we calculate a cost of 240,537.41 euro for each patient treated by ECPR with a good neurological outcome after one year. This means that, should we have strictly adhered to the ECPR inclusion criteria, 628,199.08 euro (24.6 % of the original total cost) would have been saved. On the other hand, this would also mean that (in the worst-case scenario) 2 patients who now survived after one year with good neurological outcome, would not have been treated with ECPR (and most likely would have died). Further details are presented in Table 3.

The charged fees of the different billing codes (per category) are shown in Table 4. These numbers represent the cost of the different billing codes (per category), that are charged to the patient. Zero euro cost for certain billing codes (for example: "replacement of ECMO equipment") can be explained by the fact that these costs are paid by the hospital and not charged to the patient. Almost 70 percent of all expenses were attributable to the categories nursing, medication, blood products and cost directly linked to ECLS.

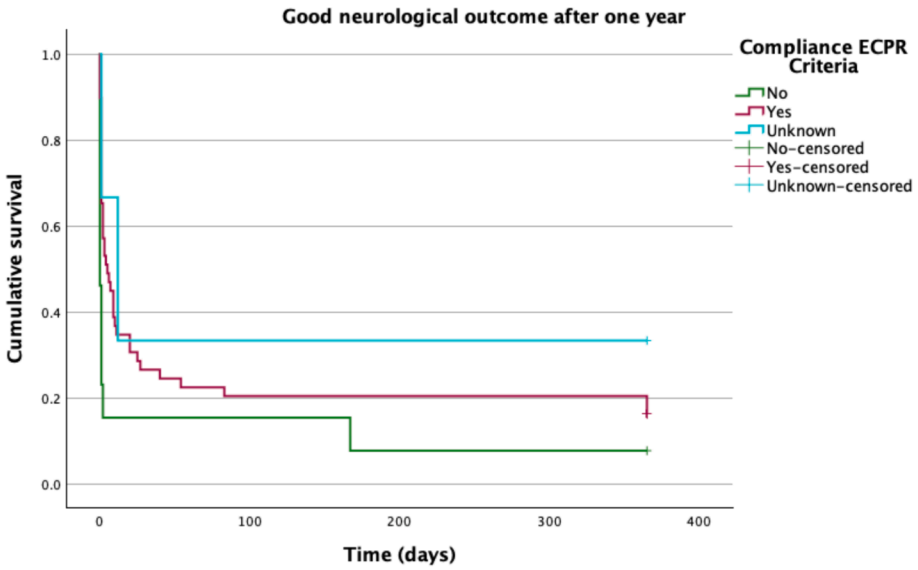

Fig. 2. Kaplan-Meier curve showing survival distribution of patients with a good neurological outcome after one year, comparing for compliance with the Extra-corporeal Cardiopulmonary Resuscitation (ECPR) inclusion criteria. Good neurological outcome was defined as a Cerebral Performance Category (CPC) score of 1 or 2.

Table 3
Total cost & outcome.

		Compliance with ECPR criteria						Total	
		No		Yes		Unknown			
		Total cost (%)	Count (%)	Total cost (%)	Count (%)	Total cost (%)	Count (%)	Total cost (%)	Count (%)
One year survival	No	475,326.91 (18.6 %)	12 (18.5 %)	1,237,941.03 (48.5 %)	39 (60.0 %)	25,261.88 (1.0 %)	2 (3.1 %)	1,738,529.82 (68.1 %)	53 (81.5 %)
	Yes	25,210.36 (1.0 %)	1 (1.5 %)	686,358.23 (26.9 %)	10 (15.4 %)	102,399.93 (4.0 %)	1 (1.5 %)	813,968.52 (31.9 %)	12 (18.5 %)
Good neurological outcome after one year	No	475,326.91 (18.6 %)	12 (18.5 %)	1,358,222.01 (53.2 %)	41 (63.1 %)	25,261.88 (1.0 %)	2 (3.1 %)	1,858,810.80 (72.8 %)	55 (84.6 %)
	Yes	25,210.36 (1.0 %)	1 (1.5 %)	566,077.25 (22.2 %)	8 (12.3 %)	102,399.93 (4.0 %)	1 (1.5 %)	693,687.54 (27.2 %)	10 (15.4 %)
Total		500,537.27 (19.6 %)	13 (20.0 %)	1,924,299.26 (75.4 %)	49 (75.4 %)	127,661.81 (5.0 %)	3 (4.6 %)	2,552,498.34 (100 %)	65 (100 %)

All cost in euros; Total cost for all patients per category with percentage of total cost; Number of patients per category with percentage of total population; Good neurological outcome = Cerebral Performance Category (CPC) 1 or 2.

Discussion

The purpose of this study was to analyse and to report characteristics, outcome and cost of adult patients treated with ECPR after OHCA. The use of ECPR for OHCA has been associated with survival rates between 6.9 % and 56 %, but the inclusion criteria of patients vary between studies and may contribute to the wide range of survival rates.[21] For conventional CPR, the EuReCa2 study reported an overall survival rate of 8 % after OHCA in Europe as well as in Belgium.[3] A systematic review and *meta*-analysis including 56 studies from Europe reported a survival to discharge rate of 11.7 % (95 % CI 10.5–13.0 %) after conventional CPR.[22].

A multi-centre observational study examined the relationship between arrest rhythm and neurological outcome in patients treated with ECPR for OHCA.[23] VF or pulseless ventricular tachycardia (pVT) that was sustained until the initiation of ECPR was associated with favourable neurological outcome, and patients who initially had VF or pVT but converted to PEA or asystole prior to ECPR initiation had no neurological benefit from ECPR.[23] In our patient cohort PEA was the second most frequent initial rhythm and was not always associated with unfavourable outcome. We suspect that some of these patients were actually in a profound state of shock with minimal circulation ("low flow state") instead of true PEA ("no flow state"). Increasing evidence shows how difficult true PEA can be distinguished from profound shock.[24–25] Therefore, we would suggest that PEA is not always an exclusion criteria for ECPR. The inclusion and exclusion criteria for this potentially life-saving therapy continue to be an area of uncertainty and of active research.[15] While ECPR may increase survival in selected patients, it is a resource-intensive therapy, and inappropriate patient selection may lead to significant increases in resource utilisation without improved outcome.

Our study differs from previous studies by calculating the medical expenses that were charged as fees to the patient. By using the micro costing technique, we could determine the precise cost that was billed. We also determined how the reimbursements by the public Belgian healthcare system supports patients in lowering their final cost. As mentioned above, the average of all charged fees was 39,269 euro per patient, which is lower than the cost reported in the literature (ranging from 46,657 to 140,172 euro).[26–27] This difference could be explained by the fact we used micro costing whereas previous literature mainly estimated the cost for the hospital itself by ways of macro costing, resulting in wider margins of error.[26] We observed significant

Table 4
Cost of billing codes per category.

	Total cost	%	Max.	Min.	Med.
Anaesthesiology	62,780.47	2.5	880.61	0.00	23.12
Blood products	180,851.89	7.1	5,218.50	93.25	248.24
ECMO	279,541.59	11.0	1,330.35	0.00	128.45
Functional examinations	24,011.91	0.9	307.98	0.00	18.19
Honoraria	100,339.39	3.9	395.72	0.00	26.33
Imaging	95,152.42	3.7	259.43	0.00	12.85
Interventional cardiology	158,329.14	6.2	13,401.26	0.00	148.74
Laboratory	177,913.62	7.0	1,425.47	0.00	1.26
Medical equipment	14,532.80	0.6	497.45	0.00	0.00
Medication	263,378.08	10.3	9,793.63	0.00	1.22
Microbiology	8,890.20	0.3	66.04	0.00	2.40
Nursing	1,059,953.82	41.5	765.41	0.00	0.85
Renal Replacement Therapy	63,731.68	2.5	262.44	123.27	259.20
Surgery	63,091.33	2.5	3,509.37	0.00	168.37
Total	2,552,498.34	100	358,722.91	5,714.29	24,279.79

All cost in euro; Total cost: sum of the different billing codes in their respective category; Percentage of total cost; Max.: Maximum cost of the different billing codes in their respective category; Min.: Minimum cost of the different billing codes in their respective category; Med.: Median cost of the different billing codes in their respective category.

differences between patients regarding the total cost per patient. The minimum cost charged per patient was 5,714.29 euro, the maximum cost was 385,722.91 euro. The reason for this important difference can be explained by the rapidly declining survival curve of OHCA patients after ECPR. Most non-survivors did not survive beyond the first week of ECLS, which therefore resulted in a reduced cost compared to the average cost per patient with a good neurological outcome. Further research is needed to extend the follow-up of the survivors and to assess the cost-utility of ECPR and to identify whether other factors, such as patient characteristics, affect the cost-utility benefit.[15,27].

ECPR could represent not only a bridge to recovery for OHCA patients but also the opportunity of saving the lives of others by organ donation. This could potentially improve the cost-effectiveness of ECPR.[28] Currently, there is limited evidence on how patients treated by ECPR and their families feel about information sharing, end-of-life care, organ donation, and the perceived value of ECPR. Further research is needed to define the optimal methods and timing for discussions of organ donation, especially for treatments with a relatively low likelihood of success.[29]

Limitations

We did not compare the cost of ECPR treatment with conventional treatment for OHCA patients and neither did we have a matched control cohort. Therefore, we cannot distinguish between the costs borne by all OHCA patients and those that are additional for ECPR patients. The time needed for medical personnel to perform specific procedures or to administer specific care may be measured in a prospective study, but these data were not available to us because of the retrospective nature of our study. Therefore, staffing time was not accounted for in the total cost. In our health system only the placement of ECLS and the first three days of therapy can be billed to the patients. Additional cost for replacement of ECLS equipment (cannulas, oxygenators, etc.), further maintenance and re-initiation of ECLS after removal, are all cost borne by the hospital because these are not reimbursed by the public Belgian healthcare system. These costs were not included in the total cost analysis because they were not billed to the patients. This limits our ability to calculate the true total cost for operating and sustaining our ECPR-programme.

Conclusion

The utilisation of ECPR presents a promising but financially demanding approach in the management of cardiac arrest patients. Our exploration of the cost associated with ECPR underscores the intricate balance between the potential for improved patient outcomes and the economic burden placed on our healthcare system. Future research should investigate if the cost effectiveness of ECPR can be improved by strict patient selection and optimising resource utilisation. These topics should be part of any ECPR quality improvement program. As research in this field continues to evolve, it is imperative for healthcare stakeholders to carefully weigh the financial implications against the potential clinical benefits, ensuring equitable access to this life-saving intervention while maintaining financial responsibility within healthcare systems. Through collaborative efforts in research, policymaking, and healthcare delivery, we can strive towards a future where ECPR remains a vital tool in the armamentarium of resuscitative strategies, enhancing both patient outcomes and the sustainability of healthcare systems worldwide.

CRediT authorship contribution statement

Dennis De Blick: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Bert Peeters:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Philip Verdonck:** Writing – review & editing, Visualization, Resources. **Erwin Snijders:** Writing – review & editing, Visualization, Resources. **Karen Peeters:** Writing – review & editing, Visualization, Resources. **Inez Rodrigus:** Writing – review & editing, Visualization, Resources. **Jan Coveliers:** Writing – review & editing, Visualization, Resources. **Rudi De Paep:** Writing – review & editing, Visualization, Resources. **Philippe G. Jorens:** Writing – review & editing, Visualization, Resources. **Hein Heidbuchel:** Writing – review & editing, Visualization, Resources. **Gerdy Debeuckelaere:** Writing – review & editing, Visualization, Resources. **Koenraad G. Monsieurs:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. No funding was received.

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