



## Clinical paper

Health related quality of life after extracorporeal cardiopulmonary resuscitation in refractory cardiac arrest<sup>☆</sup>

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## ABSTRACT

**Background:** Recent data identifies extracorporeal cardio-pulmonary resuscitation (eCPR) as a potential addendum of conventional cardiopulmonary-resuscitation (cCPR) in highly specified circumstances and selected patients. However, consented criteria indicating eCPR are lacking. Therefore we provide first insights into the health-related quality of life (HRQoL) outcomes of patients treated with eCPR in a real world setting.

**Methods:** Retrospective single-center experience of 60 consecutive patients treated with eCPR between 01/2014 and 06/2016 providing 1-year survival- and HRQoL data obtained through the Short-Form 36 Survey (SF-36) after refractory out-of-hospital- (OHCA) and in-hospital cardiac arrest (IHCA) of presumed cardiac etiology.

**Results:** Resuscitation efforts until initiation of eCPR averaged  $66 \pm 35$  min and 63.3% of the patients suffered from OHCA. Fifty-five (91.7%) of the overall events were witnessed and bystander-CPR was performed in 73.3% ( $n = 44$ ) of cases. Cause of arrest was dominated by acute myocardial infarction (AMI, 66.7%) and initial rhythm slightly outbalanced by ventricular fibrillation/tachycardia (VF/VT 53.3%). 12-month survival was 31%. Survivors experienced more often bystander-CPR ( $p = .001$ ) and a shorter duration of cCPR ( $p = .002$ ). While mid-term survivors' perceived HRQoL was compromised compared to controls ( $p \leq .0001$  for *PF, RP, RE and BP*;  $p = .007$  for *GH*;  $p = .016$  for *SF*;  $p = .030$  for *MH*;  $p = .108$  for *VT*), scores however resembled HRQoL of subjects on hemodialysis, following cardiogenic shock or pulmonary failure treated with extracorporeal membrane oxygenation (ECMO).

**Conclusions:** While HRQoL scores of our survivors ranged markedly below controls, compared to patients on chronic hemodialysis, following ECMO for cardiogenic shock or pulmonary failure most of the discrepancies ameliorated. Thus, successful eCPR in properly selected patients does translate into an encouraging HRQoL approximating chronic renal failure.

## Introduction

Advanced life support (ALS) consisting of chest compressions, defibrillation, ventilation and medication as well as addressing reversible causes constitutes the standard of care for patients suffering from cardiac arrest deemed eligible for resuscitation [1]. Improvements of these central components and of the appendant post-resuscitation care procedures resulted in increased survival to discharge rates in a recent large US-registry from 5.7% to 8.3% [2]. But overall, favorable outcomes especially in out of hospital cardiac arrest (OHCA) remain disappointing and ranged close to 7–9% for three decades [3–5]. Moreover, achieving a favorable neurologic outcome with conventional

resuscitation (cCPR) is highly time-sensitive, becoming unlikely once CPR duration exceeds 15–20 min and is described as low as 1% after 37 min and therefore possibly even delineating futility [5–8]. As of now, non-randomized survival- and gross-neurologic outcome data suggest consideration of extracorporeal cardio-pulmonary resuscitation (eCPR) as an adjunctive treatment in refractory arrest, and thus was incorporated into the current resuscitation-guidelines [9–11]. However, survival does not translate into favorable neurological outcome by default and this again not innately into quality of life.

At the same time the latest Extracorporeal Life Support Organisation (ELSO) data [12] illustrate a steep increase in the usage of eCPR though reliable data regarding indications for eCPR are still evolving and

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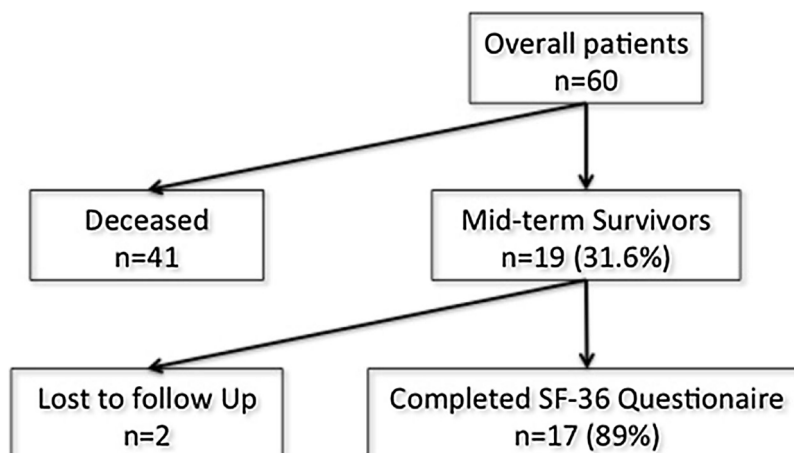


Fig. 1. HRQoL Patients.

health-related quality of life (HRQoL) data are nearly absent. Therefore we tried to close this gap in knowledge and elucidate the HRQoL outcomes of patients being treated under current circumstances. Our study reports categorized health related quality of life data from an eCPR program including a bundle of percutaneous approach, immediate coronary angiography and targeted temperature management.

## Methods

### Patient population

We investigated sixty consecutive patients with refractory cardiac arrest (ALS  $\geq$  20 min) of presumed cardiac etiology who were treated with eCPR between January 2014 and June 2016 in our center for refractory OHCA or in-hospital cardiac arrest (IHCA). To clarify on HRQoL in a real world eCPR collective HRQoL was obtained by administering the Short-Form 36 Survey (SF-36) to consenting survivors 6–12 months after discharge and included IHCA and OHCA patients alike (Fig. 1).

### Procedural details and extracorporeal membrane oxygenation (ECMO)-systems

eCPR was commenced in the cardiac-catheterization laboratory (CCL) in 59 patients and in the intensive-care unit (ICU) in one case. Utilized ECMO-systems were the Cardiohelp (MAQUET Cardiopulmonary, Hirrlingen, Germany) in 47 runs, LifeBridge (Zoll Medical) in 13 runs and RotaFlow (MAQUET Cardiopulmonary, Hirrlingen, Germany) in 5 runs. Decision to use a specific system was made on availability, in 5 cases two systems were applied to the same patient due to regulatory issues (i.e. restrictions on use > 6 h). Alerting of the cardiologist team responsible for indication and implantation, the intrahospital allocation and implantation procedure, as well as critical care management following extracorporeal facilitated return of spontaneous circulation (eROSC) were performed as described in detail previously, including targeted temperature management [13–15]. Our strategy in OHCA is to perform the eligibility-check of the patient (witnessed; bystander-CPR; reasonable age-appearance; rhythm & eCPR-duration) while unloading from the ambulance and until reaching the triage-point in the emergency department (ED) ambulance-entrance area. If deemed eligible patient and team proceed directly to the CCL (bypassing the ED).

### Quality of life follow up

Following consultation of the local ethics commission, survivors were contacted  $\geq$  6 months after discharge and HRQoL was recorded in

89% (n = 17) of the survivors using the SF-36 (Fig. 1)[16] (App-Based; MircoMovie Media GmbH). As information regarding HRQoL is lacking in the IHCA and OHCA-eCPR setting alike we included both collectives for further analysis and evaluated HRQoL-differences in between these entities as well. Data were obtained through a personal or phone-interview. The SF-36 survey consists of 8 scales: physical functioning (PF), role-physical (RP), bodily-pain (BP), general health (GH), role-emotional (RE), social functioning (SF) and mental-health (MH) as well as vitality (VT). In general, the SF-36 generates information on how the patient has perceived the individual HRQoL in the preceding four weeks and has been validated in several acute and chronic healthcare settings and to a lesser degree in cardiac arrest [17–25]. Two patients refused to participate for personal reasons. In order to elucidate the influence of cardiac arrest, critical illness and access strategy on HRQoL and as absolute numbers are difficult to interpret, the registered SF-36-scores of our patients were compared (i) to results from the German Federal Health Survey (“Bundesgesundheitsurvey”; GFHS [26]) as a sample group consisting of average inhabitants of Germany, (ii) with long term survivors of refractory cardiogenic shock necessitating veno-arterial (va) ECMO for hemodynamic stabilization [27], (iii) with long term survivors of refractory pulmonary failure necessitating veno-venous (vv) ECMO for respiratory stabilization [28], (iv) with survivors of surgical-access eCPR [29] and (v) with patients in the setting of chronic organ failure (i.e. chronic renal failure – CRF) as it is present in patients on hemodialysis [30]. To account for group characteristics as well, our West-German, predominantly male (80%) and middle aged ( $57.6 \pm 12.8$  years) patients SF-36 scores were additionally compared to the corresponding scores from a subgroup of (i) male GFHS-participants from (ii) western Germany in the (ii) age-group of 50–60 years.

### Data analysis

Continuous data were described as means and standard deviations. Differences of metric variables between the two groups were analyzed with Student’s *t*-test, if the data were normally distributed, and with Mann-Whitney test for non normally distributed data, using GraphPad Prism 6 (GraphPad Software Inc., San Diego, California). Categorical data were described with absolute and relative frequencies. Differences between categorical variables were evaluated with Fisher’s exact test. All *p* values are 2-sided and  $p \leq .05$  was considered statistically significant.

## Results

### Survival and associated variables

Overall survival 12 months after refractory cardiac arrest treated with eCPR was 31.7% and individual follow-up at the time of

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