Outcome of Extracorporeal Membrane Oxygenation Use in Cardiopulmonary Resuscitation

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A. Study Purpose and Rationale

Cardiopulmonary resuscitation (CPR) was first developed in the 1960s in order to maintain circulation and ventilation in the body while other correctable life-threatening processes were reversed. A review of the National Registry of Cardiopulmonary Resuscitation records found that 44% of in hospital cardiac arrest patients regained return of spontaneous circulation (ROSC) following conventional CPR (CCPR), i.e. the use of non-invasive mechanical compressions to generate cardiac output. However, only 17% of these patients survived to discharge. In particular, adult patients in cardiac arrest who are refractory to maximal medical therapy and CCPR have poor survival outcomes. Extracorporeal cardiopulmonary resuscitation (ECPR), the use of VA ECMO (veno-arterial extracorporeal membrane oxygenation) to generate cardiac output when conventional resuscitation and medical therapy have failed, has been shown to improve survival to discharge rates in patients who are refractory to CCPR and maximal medical therapy. Data have shown that in adult patients undergoing CCPR who are faced with imminent death, institution of extracorporeal CPR (ECPR) has been associated with a survival rate between 7.4 and 27%, which can be as low as 2% if CCPR goes beyond 10 minutes.

The purpose of this study is to evaluate the potential success of ECMO during a resuscitation attempt and the risk factors for developing complications when using ECMO for this purpose. ECMO involves the use of an extracorporeal circuit to support the function of the heart and lungs until the resolution of the underlying disease, until an organ transplant becomes available, or until cessation of life. Patients on ECMO require increased supervision and medical care; for example, they require anticoagulation to prevent clot formation within the extracorporeal circuit. Patients on ECMO frequently develop complications that lead to premature morbidity and mortality. Furthermore, ECMO is an expensive and resource-consuming therapy, and therefore its benefits must clearly outweigh the downsides prior to initiation. Elucidation of the exact benefit of ECMO in CPR and factors that identify ECMO patients at greater risk for developing these post-CPR complications may help healthcare professionals triage the patients who should be initiated on ECMO during CPR. If the patient meets the criteria, ECPR may be a patient's final option for survival and may allow time for diagnostics and therapeutic intervention.

We hypothesize that use of ECMO will increase the rates of survival to discharge in cardiac arrest patients. We also surmise that specific preliminary patient characteristics, e.g. demographics, medications, surgical history, renal and hepatic status, and laboratory results, will predispose patients at greater risk for developing complications while on ECMO. The benefits of ECPR and a clearer understanding of the patients for whom ECPR will be most effective will be clinically relevant in in-hospital cardiac arrest patients.

B. Study Design and Statistical Analysis

The proposed study is an analysis of existing electronic medical record data that includes approximately 200 ECMO procedures performed at New York Presbyterian Hospital (NYPH) between 01/01/2004 and 01/01/2014; approximately 50 of these were initiated as part of CPR. Data will be obtained from the NYPH/CUMC Department of Surgery Clinical Informatics Database, the New York Department of Health Database, and the electronic medical records used at NYP including: Eclypsis, Webcis, and Crown. The dataset will include demographic and clinical variables that will aide in the analysis of indicators for better clinical prognosis.

Chi-square tests and multiple logistic regression modeling will be used to analyze the potential risk factors for success of ECPR as well as the rate of developing complications on ECMCO. Pertinent baseline patient laboratory characteristics include: hepatic and renal status, hemoglobin levels, coagulation profile, blood gas data, and metabolic panel results. Multiple testing adjustments will be introduced as needed in order to control for potential confounders. Analysis will be completed using SAS statistical software, version 9.3.

Chi-square test analysis:
In 10 years (2004-2013), approximately 50 cases of ECPR
In 10 years, approximately 100 additional CCPR per year, total of 1,000
Ratio of C-CPR to E-CPR 20:1
Current survival to discharge: approximately 20%
Expected survival to discharge: 40%

Group 1 size: 49
Group 2 size: 985

Alpha: 0.05
Power: 80%

RANDOMIZATION:
It is difficult to perform a randomized control trial on patients who achieve ROSC. Instead a propensity analysis will be used to match the cases (ECPR) and controls (CCPR). A number of parameters will be investigated, including: age, sex, initial cardiac rhythm, duration of CPR, timing and location of CPR, presence of comorbidities, and hepatic and renal status (especially need for HD).

C. Study Procedure.

A list of patient medical record numbers that meet the inclusion criteria/patient population will be generated and the records reviewed. This study will access clinical data readily available through electronic and paper medical records systems, quality assurance data systems, and other electronic and paper data systems that capture data routinely collected as part of the patients' clinical records. Data analysis will include all adult patients (>18 y/o) who underwent ECMO at NYP/CUMC as recorded by the New York Department of Health Database 01/01/2004 to 01/01/2014, in particular the subgroup of patients who underwent ECMO initiation as part of CPR. Survival rates to discharge will be calculated for the ECPR and the CCPR groups and compared. Among the ECPR patients, analyses comparing the baseline patient demographics, lab results, and CPR metrics (e.g. duration) will be performed with the goal of interpreting which factors influenced their ability to survive to discharge or not.

A HIPAA trained research assistant assigned to this protocol will conduct retrospective chart review utilizing Eclypsis to collect data variables. A secure password-protected database will be set up and used for data storage and statistical analysis purposes. Only the PI and appropriate protocol members will have access to the data. All data for this study will be stored on a secure password-protected computer, and all data on disc will be encrypted.

D. Study Drugs*

There are no study drugs involved in this study.

E. Medical Device.*

There are no medical devices involved in this study.

F. Study Questionnaires

There are no study questionnaires for this study.

G. Study Subjects

We will be identifying all adult patients (>18 y/o) who underwent ECMO at NYP/CUMC as recorded by the New York Department of Health Database 01/01/2004 to 01/01/2014. The study will include both men and women, regardless of race, ethnicity, socioeconomic background, or religion. Patients under the age of 18 will be excluded.

All patients in the study will have received CPR for > 10 minutes.

No vulnerable patient populations will be included.

H. Recruitment of Subjects

There is no recruitment of subjects, as this is a retrospective study of patients already admitted to CUMC.

I. Confidentiality of Study Data

All study data will be coded. Patients are identified by their NYP medical record numbers. These databases are stored on password-protected computer drives, and only available to the researches explicitly listed on the IRB. The data in the statistical analyses is anonymized.

J. Potential Conflict of Interest

There are no conflicts of interest.

K. Location of the Study

The study is a retrospective analysis. All clinical aspects of the care were administered in the CUMC hospital, particularly the intensive care unit. The research analysis is to be performed at CUMC as well.

L. Potential Risks

There are no risks involved. The study is retrospective.

M. Potential BenefIts

The benefit of the study is the advancement of medical knowledge.

N. Alternative Therapies

This study does not involve experimental therapy.

0. Compensation to Subjects

No compensation will be provided.

P. Costs to Subjects

There is no additional cost to the subjects.

Q. Minors as Research Subjects

This study does not involve any minros.

R. Radiation or Radioactive Substances

No radiation or radioactive substances will be used.

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