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Intra-Aortic Balloon Pump Counterpulsation in the Post-Resuscitation Period is Associated with Improved Functional Outcomes in Patients Surviving an Out-of Hospital Cardiac Arrest: Insights from a Dedicated Heart Attack Centre

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Background

Despite advances in cardiopulmonary resuscitation, functional survival remains low after out-of-hospital cardiac arrest (OOHCA). Intra-aortic balloon pump (IABP) therapy has recently been shown to augment cerebral blood flow. Whether IABP therapy in the post-resuscitation period improves functional outcomes is unknown.

Methods

We analysed 174 consecutive patients who were successfully resuscitated from an OOHCA between 2011-2013 at Harefield Hospital, London. We analysed functional status at discharge and mortality up to one year.

Results

A total of 55 patients (32.1%) received IABP therapy. Comparing those receiving IABP with those not receiving IABP, there was no difference in favourable functional status at discharge (49.1% vs. 57.1%, $p=0.321$); and mortality at one year (45.5% vs. 35.5%, $p=0.164$). Multivariable analyses identified IABP therapy as a strong independent predictor for favourable functional status at discharge (OR=7.51, 95% CI: 2.15-26.14, $p=0.002$) and this association was maintained in propensity-score adjusted analyses (OR=9.90, 95% CI: 2.11-46.33, $p=0.004$) and inverse probability treatment weighted analyses (OR=10.84, 95% CI: 2.75-42.69, $p<0.001$). However, IABP therapy was not an independent predictor for mortality at one

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year (HR=0.93, 95% CI: 0.52-1.65, p=0.810) and this was confirmed in both propensity-score adjusted and inverse probability treatment weighted analyses.

Conclusions

In this observational analysis of patients surviving an OOHCA, the use of IABP therapy in the post-resuscitation period was associated with improved functional outcomes. This warrants further evaluation in larger prospective studies.

Keywords

Out-of-hospital cardiac arrest • Intra-aortic balloon pump • Functional survival

Introduction

Despite advances in cardiopulmonary resuscitation (CPR), both survival and favourable functional status at discharge remain low after out-of-hospital cardiac arrest (OOHCA) [1,2]. Following successful resuscitation of patients, a low cardiac output state combined with a high systemic vascular resistance potentiates poor systemic perfusion and secondary injury to multiple organs, especially the brain[3]. Thus measures to improve cardiac output to ultimately increase cerebral perfusion may be associated with improved functional recovery. Intra-aortic balloon pump (IABP) counterpulsation is a commonly used treatment for patients with cardiogenic shock[4]. The inflation of the balloon in the descending aorta in diastole enhances the diastolic pressure in the aortic arch and its active deflation in systole results in afterload reduction[4,5]. Recently, IABP therapy has been shown to increase cerebral blood flow, particularly in those with impaired left ventricular function[6]. In the post-resuscitation period, IABP therapy may provide a means for enhancing cerebral blood flow and improving functional outcomes. There are no studies that have specifically examined the benefit of IABP therapy in patients successfully resuscitated from OOHCA. Thus we conducted an observational analysis to look at the association between IABP therapy in the post-resuscitation period and outcomes in patients surviving an OOHCA at Harefield Hospital, one of the eight designated Heart Attack Centres (HAC) in Greater London, UK.

Methods

Population Study and Design

This was an observational analysis to determine the association of IABP use in the post-resuscitation period with favourable functional status at discharge and long-term survival. Since 2011, the London Ambulance Service (LAS) has embarked on a new clinical care pathway enabling ambulance clinicians to bypass the nearest hospital and transfer patients with OOHCA, if the aetiology was considered primarily cardiac, directly to one of eight Heart Attack Centres (HACs) for immediate cardiac catheterisation and revascularisation, if indicated[7]. A total of 182 consecutive patients suffering an OOHCA between 2011-2013 were brought directly by the EMS to Harefield Hospital – one of the eight designated heart attack centres in London, UK. Of these,

return of spontaneous circulation was achieved in 174 patients (96%) which were included in the final analysis.

Clinical Outcomes

We analysed functional status at discharge, and all-cause mortality at 30 days and one year. The functional status at discharge was established by reviewing case notes and graded using a modified Rankin Scale (mRS). This scale grades functional status as 0 - no symptoms; 1 - no significant disability, able to carry out all usual activities despite some symptoms; 2 - slight disability, able to look after own affairs without assistance, but unable to carry out all previous activities; 3 - moderate disability, requires some help, but able to walk unassisted; 4 - moderately severe disability, unable to attend to own bodily needs without assistance, and unable to walk unassisted; 5 - severe disability, requires constant nursing care and attention, bedridden, incontinent; and 6 - dead. This grading system is widely reported in studies with OOHCA patients where mRS0-3 is indicative of favourable functional status[8-10]. Patients' survival data was obtained by linkage of patients' NHS numbers to the Office of National Statistics (ONS), which records the date of death for all patients.

Ethics

All patient identifiable information was removed prior to analysis. Because this analysis was performed on anonymised data from mandatory audit, the local ethics committee advised us that ethical approval was not required.

Statistical Analysis

Patients were divided into two groups: (1) IABP therapy and (2) No IABP therapy. All continuous variables had skewed distributions and were thus summarised as medians (lower and upper quartiles) and compared using the Mann-Whitney U-test. Categorical variables were expressed as percentages and compared using the Z-test. Multivariable logistic regression and Cox models proportional hazards regression models were used to determine independent predictors for favourable functional status and mortality. To address measured confounders, propensity-score adjusted analyses and inverse probability treatment weighted (IPTW) analyses were performed. The variables included in the propensity score model were age, sex, Charlson Comorbidity Index (CMI), diabetes, renal disease, peripheral vascular disease, witnessed arrest, bystander CPR, VT/VF as initial rhythm, delivery of shocks, adrenaline administration, duration of

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