Published in final edited form as:

Crit Care Med. 2014 December ; 42(12): e808–e809. doi:10.1097/CCM.0000000000000650.

The authors reply

Alexis Topjian, MD, MSCE,

The Children's Hospital of Philadelphia, 34th and Civic Center Blvd, Main Building 7th Floor,
Philadelphia, PA 19104, 2155903915

Benjamin French, PhD,

The University of Pennsylvania School of Medicine

Robert Sutton, MD, MSCE,

The Children's Hospital of Philadelphia

Thomas Conlon, MD,

The Children's Hospital of Philadelphia

Vinay Nadkarni, MD,

The Children's Hospital of Philadelphia

Frank Moler, MD, MS, FCCM,

University of Michigan Medical Center

J. Michael Dean, MBA, MD, FCCM, and

University of Utah

Robert Berg, MD, FCCM

The Children's Hospital of Philadelphia

Alexis Topjian: TOPJIAN@email.chop.edu

Keywords

cardiac arrest; children; hypotension; resuscitation

We thank Dr. Spentzas (1) for his thoughtful comments in regards to our recent publication (2). He raises several interesting points that highlight both the complexity of the post cardiac arrest syndrome, while acknowledging that we are in the infancy of truly understanding how to best treat patients resuscitated from cardiac arrest(3).

Our study simply establishes an association between hypotension and mortality following pediatric cardiac arrest. Like all observational studies, this association neither proves

Copyright form disclosures:

Dr. French disclosed other: JAMA Pediatrics (Statistical Editor). Dr. Sutton received support for article research from the National Institutes of Health (NIH) and received speaking honoraria from Zoll Medical Corporation. His institution received grant support from the NIH (NICHD Career Development Award [K23]). Dr. Moler received support for article research from the NIH. His institution received grant support, support for travel, and support for participation in review activities. Dr. Dean received support for article research from the NIH. His institution received grant support from the NIH. The remaining authors have disclosed that they do not have any potential conflicts of interest.

causality nor does it guarantee that treatment will improve outcomes. In our analysis, we controlled for multiple potential confounders, including first documented rhythm and number of epinephrine doses. While we agree with Dr. Spentzas that duration of CPR was greater than 26 minutes for 25% patients with post arrest hypotension and greater than 19 minutes for 25% of patients without post arrest hypotension, we did not adjust for duration of CPR because it was collinear with the number of doses epinephrine administered. We note that adjustment for multiple potential confounders did not change the results. Recent data from Get With the Guidelines-Resuscitation showed a survival rate of 17.8% for patients who received 16–35 minutes of CPR and 15.9% for > 35 minutes of CPR (4). Based on these data, 25% of patients in both the hypotension and no hypotension groups would have similar risk for mortality.

Of the 383 patients evaluated in our study, 56% had early post arrest hypotension. Adult data from the Project Impact database showed a hypotension prevalence of 47%, with a strongly associated mortality of 65% (5). Most interestingly, of the 3030 adult patients with hypotension, 9% received vasopressor support, had no further hypotension over a 24-hour period, and had a significantly higher survival to discharge rate than those with persistent hypotension.

Unfortunately, we did not have access to data regarding volumes of fluids administered for the treatment of post-arrest hypotension, nor did any of these patients have continuous and invasive monitoring with intracranial pressure monitors or pulmonary artery catheters. As Dr. Spentzas notes, this study is only the *first* step in defining the association between post-arrest hypotension and outcomes. We believe that future prospective trials should evaluate the association of duration and severity of hypotension and myocardial dysfunction on outcomes, while utilizing cerebral end organ measurements of hypoxia, ischemia, and cellular metabolic crisis. Future interventional trials should assess treatment bundles including intravenous fluids, vasopressor support, cardiac and cerebral monitoring targets, as any one single treatment approach is unlikely to be effective (6).

We agree that there are markers of injury severity that predict outcome post arrest, such as patient factors, arrest factors, and post-arrest neuromonitoring biomarkers. While prognosis is important to the care we provide, we must be careful not to over interpret associations as determinants of death. We did not focus our analysis on the prediction of post arrest outcomes. During the early hours following resuscitation from cardiac arrest, prediction of mortality is fraught with uncertainty and clinicians are often unable to reliably predict outcome (7). Therefore, we would encourage clinicians to use our data to heighten their awareness of the association of early post-resuscitation hypotension with poor outcome. It is only with these observational data that we can go further to ask and answer the next questions with the hopes of improving resuscitation outcomes.

References

1. Spentzas T. Improving Survival After Pediatric Cardiopulmonary Arrest: Pay Attention to the Blood Pressure and the Time of CPR. *Crit Care Med*. 2014 in press.

2. Topjian AA, French B, Sutton RM, et al. Early postresuscitation hypotension is associated with increased mortality following pediatric cardiac arrest. *Crit Care Med*. 2014; 42:1518–1523. [PubMed: 24561563]
3. Neumar RW, Nolan JP, Adrie C, et al. Post-cardiac arrest syndrome: epidemiology, pathophysiology, treatment, and prognostication. A consensus statement from the International Liaison Committee on Resuscitation (American Heart Association, Australian and New Zealand Council on Resuscitation, European Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Asia, and the Resuscitation Council of Southern Africa); the American Heart Association Emergency Cardiovascular Care Committee; the Council on Cardiovascular Surgery and Anesthesia; the Council on Cardiopulmonary, Perioperative, and Critical Care; the Council on Clinical Cardiology; and the Stroke Council. *Circulation*. 2008; 118:2452–2483. [PubMed: 18948368]
4. Matos RI, Watson RS, Nadkarni VM, et al. Duration of Cardiopulmonary Resuscitation and Illness Category Impact Survival and Neurologic Outcomes for In-hospital Pediatric Cardiac Arrests. *Circulation*. 2013; 127:442–451. [PubMed: 23339874]
5. Trzeciak S, Jones AE, Kilgannon JH, et al. Significance of arterial hypotension after resuscitation from cardiac arrest. *Crit Care Med*. 2009; 37:2895–2903. quiz 2904. [PubMed: 19866506]
6. Rivers E, Nguyen B, Havstad S, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. *N Engl J Med*. 2001; 345:1368–1377. [PubMed: 11794169]
7. Perman SM, Kirkpatrick JN, Reitsma AM, et al. Timing of neuroprognostication in postcardiac arrest therapeutic hypothermia*. *Crit Care Med*. 2012; 40:719–724. [PubMed: 22080630]