

EDITORIAL COMMENT

Improved Outcomes for Cardiac Arrest in Children

Share the Baton With the Bystander*

Sumeet S. Chugh, MD

Los Angeles, California

We continue to grapple with the complexities of preventing and resuscitating out-of-hospital cardiac arrests (OHCAs). Of these, cardiac arrests among children clearly have the most devastating effect on communities. The study from Bardai et al. (1) based in North Holland, the Netherlands, is an important investigation with some caveats and several lessons that merit some discussion.

See page 1822

This was a prospective study in a community of 2.4 million people, with 588,389 residents younger than 21 years of age. It is important to recognize that the manner in which Bardai et al. (1) presented their data tends to overestimate the actual incidence of pediatric OHCA. Their definition of OHCA was very broad and included natural causes (cardiac and noncardiac) as well as all unnatural causes of OHCA, such as traffic accidents and violent trauma. Another reason for possible overestimation relates to their inclusion of subjects 20 years of age or younger (the 18- to 20-year age group represented 25% of total OHCAs). Nonetheless, their findings indicate that similar to adults, there is likely to be geographic variation in the annual incidence of pediatric OHCA. Even if we focus on the subgroup of natural OHCA of likely cardiac cause, the annual incidence ranges from 3.2 per 100,000 children in North Holland, the Netherlands, to 7.5 per 100,000 in Portland, Oregon (2). For the purpose of reporting, it is helpful to make a clear separation between OHCA resulting from natural causes versus that resulting from unnatural causes, because the approach to prevention is distinctly different for each category. Although childhood cardiac arrests invariably are the most devastating of the OHCAs, fortunately, they are relatively uncommon, representing 1.3% and 2.8% of

all OHCAs in North Holland, the Netherlands, and Portland, Oregon, respectively.

Similar to adults, the vast majority of pediatric OHCAs (78% in the North Holland study) are related to cardiac causes. However, the age distribution of North Holland pediatric OHCAs in this subgroup is distinct from that of earlier reports. The significantly lower proportion of infants (39%) is a departure from the expected highest rates in the younger than 1 year age group compared with older pediatric age groups, and the authors point us to published data that suggests a 5.7-fold higher incidence of sudden infant death syndrome (SIDS) in the United States compared with the Netherlands (3). Because they do not provide us with any information regarding what proportion of infants had a diagnosis of SIDS, we have to assume that the rates of SIDS are lower compared with those of other communities. Although successful SIDS prevention through education and modification of behavior and societal or cultural practices is a well-established strategy, the North Holland findings could indicate that there is significant room for improvement in prevention of SIDS in other parts of the world.

The most striking findings of the North Holland study relate to the outcome of resuscitated pediatric OHCAs, both in terms of survival to hospital discharge as well as neurologic recovery. The overall rate of survival to hospital discharge was 24% (12 of 51), and the overall rate of neurologic recovery was 83%. When taken in the context of the existing literature (6.4% survival in a recent large North American experience [4]), this is an enviable rate of survival and neurologic recovery for pediatric OHCAs. OHCAs with ventricular tachycardia or ventricular fibrillation, as opposed to pulseless electrical activity or asystole, are significantly more likely to survive, and Bardai et al. (1) report high rates of ventricular tachycardia or ventricular fibrillation (36% overall, with 83% among adolescents). However, these rates do not seem to be explained by the somewhat modest response times that are in the range of 11 to 12 min. It is likely, therefore, that this favorable outcome is attributable to the high rates of witnessed collapse, bystander cardiopulmonary resuscitation, and use of automated external defibrillators. Although there are other factors, such as population density and overall education level of residents, that likely contribute to the survival advantage enjoyed by North Holland pediatric residents, this solid outcome clearly reflects successful bystander education in a well-deployed emergency medical response system.

Bardai et al. (1) need to be congratulated for their impressive work in a sizable community. Although their community may have some specific characteristics that are not transferable to other regions, the excellent survival and neurologic recovery rates are unmistakable and demonstrate the feasibility of attaining better outcomes for pediatric OHCA, especially by increasing awareness within the community. Improved bystander CPR, as well as use of automated external defibrillators, are likely to be of particular

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of *JACC* or the American College of Cardiology.

From the Heart Institute, Cedars-Sinai Medical Center, Los Angeles, California. Dr. Chugh is the Pauline and Harold Price Professor of Cardiac Electrophysiology at the Cedars-Sinai Heart Institute, Los Angeles, California; there are no other relationships to disclose.

benefit for resuscitation in children. Simultaneously, because most naturally occurring pediatric sudden deaths are likely to be cardiac, we also must continue to focus our efforts on prevention. Although SIDS is acknowledged to be a complex disorder with multiple causes, major inroads have also been made by focused community-based educational interventions (3). In addition, the younger the age, the higher the likelihood of a genetic cause. A renewed emphasis needs to be placed on community health care providers obtaining detailed family histories with appropriate referral for genetic screening and counseling. In the event of unexplained sudden deaths, a molecular autopsy (5,6) should become part of the community forensic investigation as a critical means of enhancing prevention for family members who are left behind.

Reprint requests and correspondence: Dr. Sumeet S. Chugh, The Heart Institute, 5702 South Tower, Cedars-Sinai Medical Center, 8700 Beverly Boulevard, Los Angeles, California 90048. E-mail sumeet.chugh@cshs.org.

REFERENCES

1. Bardai A, Berdowski J, van der Werf C, et al. Incidence, causes, and outcomes of out-of-hospital cardiac arrest in children: a comprehensive, prospective, population-based study in the Netherlands. *J Am Coll Cardiol* 2011;57:1822–8.
2. Chugh SS, Reinier K, Balaji S, et al. Population-based analysis of sudden death in children: the Oregon Sudden Unexpected Death Study. *Heart Rhythm* 2009;6:1618–22.
3. Moon RY, Horne RS, Hauck FR. Sudden infant death syndrome. *Lancet* 2007;370:1578–87.
4. Atkins DL, Everson-Stewart S, Sears GK, et al. Epidemiology and outcomes from out-of-hospital cardiac arrest in children: the Resuscitation Outcomes Consortium Epistry-Cardiac Arrest. *Circulation* 2009;119:1484–91.
5. Chugh SS, Senashova O, Watts A, et al. Postmortem molecular screening in unexplained sudden death. *J Am Coll Cardiol* 2004;43:1625–9.
6. Tan HL, Hofman N, van Langen IM, van der Wal AC, Wilde AA. Sudden unexplained death: heritability and diagnostic yield of cardiological and genetic examination in surviving relatives. *Circulation* 2005;112:207–13.

Key Words: bystander ■ cardiac arrest ■ death ■ pediatric ■ population ■ sudden ■ survival.