

References

1. Ramachandran SK, Mhyre J, Kheterpal S, Christensen RE, Tallman K, Morris M, Chan PS; American Heart Association's Get With The Guidelines-Resuscitation Investigators: Predictors of survival from perioperative cardiopulmonary arrests: A retrospective analysis of 2,524 events from the Get With The Guidelines-Resuscitation Registry. *ANESTHESIOLOGY* 2013; 119:1322–39
2. Girotra S, Spertus JA, Li Y, Berg RA, Nadkarni VM, Chan PS; American Heart Association Get With the Guidelines-Resuscitation Investigators: Survival trends in pediatric in-hospital cardiac arrests: An analysis from Get With the Guidelines-Resuscitation. *Circ Cardiovasc Qual Outcomes* 2013; 6:42–9
3. Bradley SM, Huszti E, Warren SA, Merchant RM, Sayre MR, Nichol G: Duration of hospital participation in Get With the Guidelines-Resuscitation and survival of in-hospital cardiac arrest. *Resuscitation* 2012; 83:1349–57
4. Merchant RM, Yang L, Becker LB, Berg RA, Nadkarni V, Nichol G, Carr BG, Mitra N, Bradley SM, Abella BS, Groeneveld PW; American Heart Association Get With the Guideline-Resuscitation Investigators: Variability in case-mix adjusted in-hospital cardiac arrest rates. *Med Care* 2012; 50:124–30
5. Girotra S, Nallamothu BK, Spertus JA, Li Y, Krumholz HM, Chan PS; American Heart Association Get with the Guidelines-Resuscitation Investigators: Trends in survival after in-hospital cardiac arrest. *N Engl J Med* 2012; 367:1912–20
6. Morris M, O'Reilly M: Life-threatening critical respiratory events: A retrospective study of postoperative patients found unresponsive during analgesic therapy. *J Clin Anesth* 2011; 23:207–13
7. Wang HE, Abella BS, Callaway CW; American Heart Association National Registry of Cardiopulmonary Resuscitation Investigators: Risk of cardiopulmonary arrest after acute respiratory compromise in hospitalized patients. *Resuscitation* 2008; 79:234–40
8. Brady WJ, Gurka KK, Mehring B, Peberdy MA, O'Connor RE; American Heart Association's Get with the Guidelines (formerly, NRCPR) Investigators: In-hospital cardiac arrest: Impact of monitoring and witnessed event on patient survival and neurologic status at hospital discharge. *Resuscitation* 2011; 82:845–52
9. Topjian AA, Nadkarni VM, Berg RA: Cardiopulmonary resuscitation in children. *Curr Opin Crit Care* 2009; 15:203–8
10. Ornato JP, Peberdy MA, Reid RD, Feeser VR, Dhindsa HS; NRCPR Investigators: Impact of resuscitation system errors on survival from in-hospital cardiac arrest. *Resuscitation* 2012; 83:63–9

(Accepted for publication March 20, 2014.)

Data on the Anesthetic Procedure or Surgical Risk Are Still Necessary

To the Editor:

I have read the very interesting and detailed article by Ramachandran *et al.* recently published in *ANESTHESIOLOGY*,¹ dealing with perioperative cardiopulmonary arrest and the possibility of its prediction through a retrospective database analysis. The authors showed results on the influence (predictors) of perioperative diseases, type of cardiac rhythm when pulseless activity was detected, event location (operating room, postanesthesia care unit, intensive care area, telemetry,

or general ward), and other patient characteristics. Although designed to study the survival to hospital discharge as the primary outcome, and the neurological outcome (intact or affected by neurological disability) as the secondary one, I was surprised by the fact that several items usually (and in my opinion obligatory) included in anesthesia-related mortality and morbidity studies, as those cited by the authors^{2–4} and others,^{5–8} as are the surgical procedure (even grossly classified), any kind of risk stratification or score (American Society of Anesthesiologists' physical status, *etc.*), and, perhaps the most important, the type of anesthetic procedure the patient was subjected to, were not included in the analysis or not showed. Otherwise, the exclusion of these informative data was not clearly explained. These are important because it could explain some of the findings of the study, as the relatively high survival rates, with good neurological outcomes of asystolic arrests, and, in part, the better outcome of cardiac arrests occurring in the operating room or in the postanesthesia care unit: for instance, asystolic cardiac arrests due to spinal anesthesia have been described as with easier resuscitation and good outcomes,^{2,9} and those can occur in younger patients having better physical status. Another example would be that general anesthesia is frequently chosen in the more severe patients and in high-risk surgeries, and consequently, worse prognostic should be expected if a cardiopulmonary arrest occurs.²

Competing Interests

The author declares no competing interests.

Carlos L. Errando, M.D., Ph.D., Consorcio Hospital General Universitario de Valencia, Valencia, Spain. errando013@gmail.com

References

1. Ramachandran SK, Mhyre J, Kheterpal S, Christensen RE, Tallman K, Morris M, Chan PS; American Heart Association's Get With The Guidelines-Resuscitation Investigators: Predictors of survival from perioperative cardiopulmonary arrests: A retrospective analysis of 2,524 events from the Get With The Guidelines-Resuscitation registry. *ANESTHESIOLOGY* 2013; 119:1322–39
2. Sprung J, Warner ME, Contreras MG, Schroeder DR, Beighley CM, Wilson GA, Warner DO: Predictors of survival following cardiac arrest in patients undergoing noncardiac surgery: A study of 518,294 patients at a tertiary referral center. *ANESTHESIOLOGY* 2003; 99:259–69
3. Braz LG, Módolo NS, do Nascimento P Jr, Bruschi BA, Castiglia YM, Ganem EM, de Carvalho LR, Braz JR: Perioperative cardiac arrest: A study of 53,718 anaesthetics over 9 yr from a Brazilian teaching hospital. *Br J Anaesth* 2006; 96:569–75
4. Newland MC, Ellis SJ, Lydiatt CA, Peters KR, Tinker JH, Romberger DJ, Ullrich FA, Anderson JR: Anesthetic-related cardiac arrest and its mortality: A report covering 72,959 anesthetics over 10 years from a US teaching hospital. *ANESTHESIOLOGY* 2002; 97:108–15
5. Arbous MS, Meursing AE, van Kleef JW, de Lange JJ, Spoormans HH, Touw P, Werner FM, Grobbee DE: Impact of anesthesia management characteristics on severe morbidity and mortality. *ANESTHESIOLOGY* 2005; 102:257–68; quiz 491–2

6. Arbous MS, Grobbee DE, van Kleef JW, de Lange JJ, Spoormans HH, Touw P, Werner FM, Meursing AE: Mortality associated with anaesthesia: A qualitative analysis to identify risk factors. *Anaesthesia* 2001; 56:1141–53
7. Hove LD, Steinmetz J, Christoffersen JK, Møller A, Nielsen J, Schmidt H: Analysis of deaths related to anesthesia in the period 1996–2004 from closed claims registered by the Danish Patient Insurance Association. *ANESTHESIOLOGY* 2007; 106:675–80
8. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB: Trends in anesthesia-related death and brain damage: A closed claims analysis. *ANESTHESIOLOGY* 2006; 105:1081–6
9. Kopp SL, Horlocker TT, Warner ME, Hebl JR, Vachon CA, Schroeder DR, Gould AB Jr, Sprung J: Cardiac arrest during neuraxial anesthesia: Frequency and predisposing factors associated with survival. *Anesth Analg* 2005; 100: 855–65

(Accepted for publication March 20, 2014.)

In Reply:

The Get With The Guidelines-Resuscitation database is an American Heart Association–sponsored, prospective, multi-site, observational registry. Trained nurse abstractors input data at each site, by reviewing the medical record for in-hospital cardiac arrest (IHCA) management. The quality and completeness of site data are evaluated by a robust quality control process. Several important points have been raised by Drs. Xue *et al.* and Errando in response to our study.

1. The study has the potential for significant unmeasured confounding variables. We have acknowledged this fact in detail in our study,¹ but these limitations are generic to all observational studies. Dr. Xue points out that the duration of hospital participation could be an important confounder in predicting outcome,² but previous work within the Get With The Guidelines-Resuscitation database has not found this to be the case with IHCA.²
2. Telemetry was associated with better outcomes in IHCA with shockable rhythms, in comparison with general care and operating room locations. Only 20% of the operating room IHCA had shockable rhythms, with a preponderance of trauma and shock. Shockable rhythms were more frequent, whereas trauma or shock was less frequently seen in IHCA events occurring in telemetry locations. Thus, location-specific differences in outcome likely reflect primary differences in patient populations.
3. Monitoring was associated with improved survival in previous studies of the Get With The Guidelines-Resuscitation database.³ The presence of skilled and trained providers who recognized IHCA and instituted early defibrillation, epinephrine administration,

and invasive airway placement partially explains the improved outcomes seen in monitored locations such as the operating room and postanesthesia care unit. However, as described above, it is possible that some of this improved survival relates to indication bias, in that patients at greater risk of IHCA with shockable rhythms are more likely to receive telemetry monitoring. Thus, summary conclusions to increase monitoring levels on the general care units cannot be made based on this study alone. Although expert opinion⁴ and emerging evidence⁵ continue to point toward outcome modification with increased pulse oximetry monitoring, the largest prospective study⁶ to date failed to show survival or outcome benefit in patients. In addition, there is some evidence of serious harm with increased monitoring, prompting the Joint Commission to issue a sentinel alert in 2013.*

4. I agree that improved survival in the operating room IHCA could be explained partially by reduced resuscitation errors. The quality of resuscitation as measured by time to defibrillation, epinephrine administration, or intubation was significantly superior in the operating room, suggesting better run codes.
5. The Get With The Guidelines-Resuscitation database does not provide information on surgical procedure or anesthetic management. Databases such as the Multi-center Perioperative Outcomes Group† could provide valuable insight, but measures of cardiac resuscitation and neurological outcome are often missing from such databases.

I would like to thank the editor and the respondents to our study for the interest and look forward to more research in this area.

Competing Interests

Dr. Ramachandran was a paid *ad-hoc* consultant to Galleon Pharmaceuticals, Horsham, Pennsylvania, and Merck Sharp and Dohme, Whitehouse Station, New Jersey, in 2012–2013.

Satyra Krishna Ramachandran, M.D., F.R.C.A., University of Michigan Medical School, Ann Arbor, Michigan. rsatyak@med.umich.edu

References

1. Ramachandran SK, Mhyre J, Kheterpal S, Christensen RE, Tallman K, Morris M, Chan PS; American Heart Association's Get With The Guidelines-Resuscitation Investigators: Predictors of survival from perioperative cardiopulmonary arrests: A retrospective analysis of 2,524 events from the Get With The Guidelines-Resuscitation registry. *ANESTHESIOLOGY* 2013; 119:1322–39
2. Bradley SM, Huszti E, Warren SA, Merchant RM, Sayre MR, Nichol G: Duration of hospital participation in Get With The Guidelines-Resuscitation and survival of in-hospital cardiac arrest. *Resuscitation* 2012; 83:1349–57
3. Brady WJ, Gurka KK, Mehring B, Peberdy MA, O'Connor RE; American Heart Association's Get with the Guidelines (formerly, NRCPR) Investigators: In-hospital cardiac arrest:

* Available at: http://www.jointcommission.org/assets/1/18/sea_50_alarms_4_5_13_final1.pdf. Accessed March 7, 2014.

† Available at: <http://mpog.med.umich.edu/>. Accessed March 7, 2014.