progression to bradycardic arrest with pulselessness and unconsciousness may progress with a rapidity on the order of seconds.

Unfortunately, few of the authors of recent studies have addressed the issue of the hemodynamic pattern in the 60–120 s preceding bradycardic arrest/asystole. Even Lesser et al. (8), who published an account of their cases as recorded by automated anesthesia record keepers, did not provide the above information. Granted, this would be difficult without continuous invasive arterial blood pressure monitoring.

The focus needs to shift to detailed analysis of the hemodynamics in the minute or two leading up to bradycardic arrest and asystole during neuraxial anesthesia. This is a time frame more than adequate in which to intervene to prevent calamities.

Leo I. Stemp, MD
Mercy Medical Center
Springfield, MA
leos@cox.net

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In Response:

We would like to thank Drs. Lambert, Pollard, and Stemp for their interest in our recent article (1). It is important to note that the aim of our study was to evaluate the association of preexisting medical conditions and peri-arrest events with survival after cardiac arrest during neuraxial anesthesia. Our series, which includes only the cases of cardiac arrest and does not characterize the >35,000 patients who uneventfully received spinal or epidural block during the study period, is not able to determine factors associated with the risk of cardiac arrest itself. Thus, we are unable to definitively determine whether a smaller dose or lower sensory level would decrease the frequency of cardiac arrest during neuraxial anesthesia, as proposed by Dr. Pollard. However, Dr. Pollard's hypothesis is not supported by the 82% survival rate among patients who had a sensory level of T6 or above, which is higher than our overall survival rate of 65%.

Cardiac arrest during neuraxial block has often been described as sudden and without predisposing factors. After reviewing 14 cases of cardiac arrest during spinal anesthesia in healthy patients, Caplan et al. (2) concluded "spinal blockade—conducted under routine conditions and in a standard manner—carries a poorly understood potential for unexpected cardiac arrest and severe brain injury." Both Drs. Pollard and Stemp reflect this concern and discuss possible predisposing factors to cardiac arrest during neuraxial block, specifically the combined effects of loss of compensatory vasoconstriction, hypotension, and bradycardia. Once again, this is speculative. Despite ongoing and comprehensive reviews of cardiac arrests associated with neuraxial block, the precise mechanism(s) remain undefined and continue to be classified simply as "cardiovascular" in origin (2,3). Furthermore, preventative measures that facilitate early detection of hypotension and bradycardia as well as resuscitative techniques that reverse these hemodynamic effects do not guarantee a good outcome (3).

Unlike cases included in the American Society of Anesthesiologists Closed Claims Project (2), in over half of the patients in our series (1), the primary cause of the cardiac arrest was a specific surgical event (12 patients), preexisting cardiac condition (2 patients), vagally mediated response (2 patients), or sedation leading to respiratory depression (3 patients). In the remaining 10 of 26 (39%) patients, no other etiology was identified and the precipitating cause of the cardiac arrest was assumed to be the neuraxial block. However, it is equally important to note that the etiology of the cardiac arrest during general anesthesia is often unknown. Sprung et al. (4) attributed a "cardiac cause" as the probable source of cardiac arrest in 98 of 223 (44%) patients who arrested during noncardiac surgery; 207 of the 223 arrests were associated with a general anesthetic. Therefore, the primary cause of cardiac arrest during either neuraxial or general anesthesia is "cardiovascular" in approximately 40% of cases (and the contributing factors/mechanisms remain elusive).

Drs. Pollard and Stemp also request more details regarding the peri-arrest events and resuscitation of these patients. Much of the information requested is included in Tables 2–5. However, our study also provided these data for the patients who arrested during general anesthesia while undergoing similar surgical procedures. We propose that comparing the predisposing factors associated with survival for arrests that occur under equivalent circumstances (but different anesthetics) are the most critical results. In our series, patients who arrested under general anesthesia were more likely to have experienced hypotension than those who arrested during neuraxial block. The presenting cardiac rhythm and resuscitative efforts did not vary between groups. Importantly, cardiac arrest that occurred during neuraxial anesthesia was associated with a likelihood of survival equal to or better than an arrest during general anesthesia. We cannot determine why 50% of patients who received epinephrine did not survive despite prompt and aggressive interventions, although this has also been noted in other series (3). Autopsy diagnoses (severe coronary artery disease, massive fat, or amniotic fluid embolism) support the difficulty encountered during resuscitation.

Finally, Dr. Lambert states that successful resuscitation may not be possible in other (non-academic) centers. Existing data indirectly support this hypothesis. In their series, Sprung et al. (4) reported that arrests during nonregular working hours had worse outcomes, indicating that availability of personnel may influence survival. Likewise, the ASA Closed Claims Database continues to accrue cases of cardiac arrest that occur in unmonitored settings (obstetric ward) and/or the diagnosis is delayed (3). Although much remains to be illuminated, the available data suggest several recurring principles: cardiac arrest during neuraxial anesthesia may not always be preventable but, if promptly recognized, it is often treatable (1,3). Thus, perioperative monitoring and vigilance remain crucial to patients undergoing neuraxial anesthesia (3).

Sandra L. Kopp, MD,
Terese T. Horlocker, MD
Department of Anesthesiology
Mayo Clinic
Rochester, MN
Kopp.Sandra@mayo.edu

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Possible Air Embolism During Eye Surgery

To the Editor:

The case report "Possible Air Embolism During Eye Surgery" (1) appears on the cover index as "Severe Eye Embolism During Eye

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