Invited Commentary: RE: A Retrospective Survey of Monitoring/Safety Devices and Incidents of Cardiopulmonary Bypass for Cardiac Surgery in France

Retrospective surveys of perfusion practice and experience have provided valuable information for all clinicians and disciplines involved in open heart surgery. The most recent national survey, this time from Charrière et al. in France, represents another such survey. A distinguishing aspect of their report was the very high response rate (86%) from 57 centers performing 34,496 cardiopulmonary bypass (CPB) cases in 2005. This was perhaps because of involvement of a governmental advisory agency in the original solicitation and, secondarily, persistent follow-up by the authors to re-solicit initial non-responders. Like previous surveys cited in their report (1–5), they sought information on several known complications associated with CPB.

Besides providing data on incident rates, they also gathered patient outcome information in four categories: (i) no injury; (ii) injury without permanent sequelae but increased length of hospital stay; (iii) injury with permanent sequelae; and (iv) death. These categories have been used in prior surveys and allow for some general comparisons on trends for specific incidents with the caveat that subtle differences in the wording of questions or descriptors on a questionnaire can significantly alter responses. For example, Charrière et al. describe “coagulation of the circuit,” whereas earlier surveys described this complication as “disseminated intravascular coagulopathy,” “consumption coagulopathy,” or more broadly, “coagulation problems” or “coagulation problems following bypass.” These differences urge caution for readers in making direct comparisons or conclusions relative to the earlier reports. For example, Charrière et al. describe “coagulation of the circuit,” whereas earlier surveys described this complication as “disseminated intravascular coagulopathy,” “consumption coagulopathy,” or more broadly, “coagulation problems” or “coagulation problems following bypass.” These differences urge caution for readers in making direct comparisons or conclusions relative to the earlier reports. In another example, comparison of results for “oxygenator failure” presents similar pitfalls in analysis caused by wording differences. Failure to transfer gas is one manifestation under this broad category, as is the development of a membrane leak, both of which have been described as “oxygenator failure.” Perhaps more important, in all surveys over the last four decades [except that of Jenkins et al. (4)], the incidence of adverse patient outcome for this complication was either zero or negligible.

For another well-known complication, gas embolism from the CPB circuit, analysis is less equivocal, and in this survey, the news is good: the overall incidence rate was 8 of 30,512 cases, or 0.26 incidents per 1000 cases, and the incidence rate for an adverse patient outcome was 0.13 per 1000 cases. These data indicate a decline in the overall incidence rate ranging from 1.14 to 0.68 per 1000 cases (mean, 0.84) from four earlier surveys (1–3, 5) posing nearly identical questions on this complication. Examining the incidence of adverse patient outcome for gas embolism, the earlier surveys reported incident rates ranging from a high of 0.41 per 1000 in the 1970s (1) to 0.03 per 1000 (mean, 0.19 per 1000) in the survey of Mejak et al. (5).

How can we account for the apparent decline in this particular complication? It is tempting to ascribe increased use of so-called safety devices (e.g., arterial line filter, low level alarm, air bubble detector, or one-way valved left ventricular vent) to the current rare outcome of patient injury or death from gas embolism from the CPB circuit. However, in this survey, use of three of these four devices designed to prevent gas embolism was significantly lower than the most recent United States survey from Mejak et al. (5) published in 2000. Specifically, use of an arterial line filter was 70% in France vs. 98.5% in the United States; air bubble detector with automatic pump shutdown or sense only, 28% and 32% vs. 87.8% and 63%; and one-way valved left ventricular vent, 41% vs. 83%. Could it be that increased awareness of this complication by perfusionists and surgeons is responsible for the declining incidence? Another intriguing area of speculation is the use of a pre-CPB checklist, which, once again, was reportedly used by 79% in the current survey vs. 94.5% of respondents in the most recent US survey (5). Based on the current survey results from France, one could conclude that these known effective practices are non-contributory to safer perfusion, but intuition and unreported clinical experience argue against this conclusion.

Like an earlier survey (3) from the 1980s, the authors reported that gas embolism associated with delivery of cardioplegia was relatively common (incidence rate 0.5 per 1000 cases) and the second most frequent source of gas embolism (after inattention to reservoir level when using
a bubble oxygenator) on the earlier survey (incidence rate 0.14 per 1000 cases). However, in both reports, this complication was most often associated with no patient injury.

In Sweden, Svenmarker and Appelblad (6) recently reported on their 15-year experience with one hospital’s prospective registry of CPB-related perfusion incidents. In the current survey, 22/66, or 33%, of the reporting hospitals had in place a registry for perfusion incidents. One could speculate that perfusion complication rates would be higher if such a prospective registry was used, but the findings of Charrière et al. refute such a conclusion insofar as the incidence rates at hospitals with or without such a registry were similar. In the Swedish experience, there was a steady and dramatic decline in the number of reported incidents over the 15-year time frame, suggesting that prospective registries should be implemented in all cardiac surgery centers for ongoing quality control purposes.

In summary, Charrière et al. are to be commended for educating current clinicians with carefully collected data on contemporary perfusion practices and incidents. They forthrightly acknowledge some of the shortcomings of survey research. Their survey should be repeated in 5 years to further assess the implementation and impact of recommendations for use of safety devices and protocols in making CPB safer than the currently shown low level of risk to patients.

“Errors using inadequate data are much less than those using no data at all.” (Charles Babbage, English mathematician, philosopher, engineer, and proto-computer scientist, 1791–1871) (7)

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REFERENCES