Should Hemoglobin-Hematocrit Be Routinely Measured in Children Undergoing Minor Surgery?

To the Editor:—Because of pressure for cost containment in our health care system and with JCAH regulations stating that each health care facility is to set their own standards, we asked whether hemoglobin and hematocrit (H/H) determinations were necessary in healthy children who were undergoing anesthesia for operative procedures associated with no blood loss. A questionnaire was sent to the departments of anesthesiology of 45 free-standing children's hospitals. The questionnaire asked whether the departments of anesthesiology require measurement of hemoglobin and/or hematocrit prior to anesthetizing children needing surgery who should have minimal or no blood loss (insertion of tympanostomy tubes, repair of inguinal hernias, cystoscopies, cast changes, and x-rays or diagnostic studies).

Forty questionnaires were returned for a response rate of 89%. Thirteen respondents stated that they did not require measurement of H/H for such procedures. Nineteen responded that H/H determinations were required. Eight responded that although they would like to eliminate the requirement, they have not done so because of requirements by the hospital or another agency. If these eight were added to the 13 "no" respondents, slightly over 50% of the departments of anesthesiology in free-standing children's hospitals no longer require measurement of routine H/H on healthy children requiring surgery or procedures with minimal or no blood loss.

Ashcraft et al.* assessed 445 ASA physical status 1 or 2 pediatric patients and found a 98.6% accuracy of clinical assessment for judging whether hemoglobin concentrations were less than 10 g/dL.

Although there are no studies to support the assumption that anesthetizing healthy children with or without H/H determinations is beneficial or detrimental, by using the clinical assessment of Ashcraft et al.* we have a clinical tool on which to base the need for H/H determinations.

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Temperature Measurement and Blood Gas Reporting in Studies of Hypothermic Cardiopulmonary Bypass

To the Editor:—I read with considerable interest the report by Bashein et al. on neuropsychologic functioning after α-stat or pH-stat management during hypothermic cardiopulmonary bypass. Their study demonstrates impaired neuropsychometric performance on virtually all tests at 8 days postoperatively, changes that had largely resolved by 7 months, and that were independent of mode of pH management. I feel the conclusions of this study require qualification however; thus, some comments about the study protocol and its potential effect upon the observed outcome are warranted.

In this report, the difference in PaCO\(_2\) between the two groups was 7 mmHg (table 2), less than half that expected given a comparable degree of hypothermia during CPB. This relatively small difference in CO\(_2\) stems from the authors' correction of PaCO\(_2\) to rectal temperature rather than nasopharyngeal or esophageal temperatures. These latter temperatures more closely reflect brain cooling, responding more quickly and profoundly to temperature changes than does rectal temperature. In clinical situations, rectal temperature always remains higher than nasopharyngeal or esophageal temperatures during hypothermic CPB and can thus lead to an inappropriately low PaCO\(_2\) correction, relative to the brain. Because it is the cerebral vasodilator effect of CO\(_2\) that is presumed to be etiologic in this study, correction of PaCO\(_2\) to a more representative brain temperature would result in a considerably greater difference in PaCO\(_2\) between groups (20 mmHg at 37°C). This would have a significantly greater influence upon cerebral blood flow and therefore upon the potential for delivery of microemboli into the cerebral circulation, as well as the potential for intracerebral flow redistribution (steal). In this situation, postoperative neuropsychologic studies may well have detected a difference in outcomes.

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REFERENCES
In Reply—I thank Dr. Murkin for his interest in our paper. His comments raise important questions. First, if one decides to correct blood gas values for temperature, which is the most appropriate temperature measurement site to use? We chose rectal temperature correction because that had been the method previously employed in our institution, because we found no literature suggesting any accepted standardized site, and because we planned to investigate both cardiac and cerebral outcome and wanted a core temperature representing the body as a whole. We found that the rectal temperature lags the esophageal temperature, being higher than it during the cooling phase, nearly equal to it during stable hypothermia, and lower than it during the warming phase, in agreement with the figures of Dr. Murkin’s fourth reference. Thus, our choice of rectal temperature correction resulted in a lower $P_{CO_2}$ during cooling and a higher $P_{CO_2}$ during warming than esophageal temperature correction would have given.

How much of a difference does the measurement site make overall? Table 1 shows little difference between the mean values of the rectal, esophageal, and arterial blood temperature in 58 of our study patients having continuous temperature recordings during bypass. Below each mean temperature is shown the $P_{CO_2}$ that would be obtained using our blood gas analyzer’s formula to correct a measured $P_{CO_2}$ of 40 mmHg to that temperature. The 1 mmHg maximal differences in $P_{CO_2}$ between sites is of doubtful physiologic significance.

In order to guide our $CO_2$ management, we sampled blood gases every 10 min during bypass, yielding specimens throughout the range from normothermia to the lowest temperature reached. In reporting the data from this complex collection of temperature profiles, we chose to be conservative and present the mean of all of these specimens, giving a difference between $CO_2$ groups of only about 7 mmHg, as noted by Dr. Murkin. The magnitude of the temperature correction was larger for specimens taken at lower temperatures and smaller for specimen taken nearer to normothermia. For example, at 30.1°C, the mean of the lowest temperatures obtained in both patient groups, the calculated difference in $P_{CO_2}$ between $a$-stat and $pH$-stat is 10.4 mmHg. I apologize if our reporting the mean values has mislead some readers. Alternatively, had we reported only the $P_{CO_2}$ correction at the nadir of temperature in each patient, it would have included no information about amount of correction applied over the remainder of each bypass run.

How else could one report results involving blood gas specimens taken over bypass runs having differing temperature profiles? Because the hypothesized effects of $P_{CO_2}$ management on brain function would likely be determined by both the degree and duration of exposure, a measure including a time component has intuitive appeal. For our study, we also calculated (but did not report) what we call the $CO_2$ deficit index, i.e., the area between the straight line $P_{CO_2} = 40$ mmHg and a line connecting the patient’s measured $P_{CO_2}$ values versus time during bypass (both quantities expressed in temperature-corrected terms). This index has the value zero if perfect $pH$-stat conditions or normothermia are maintained, regardless of the duration of bypass, and it increases with lower temperature or longer time on bypass under $a$-stat conditions. The mean values obtained for this index in our study were 590.9 (SD 247.6) mmHg·min for the $a$-stat group and 146.2 (SD 137.2) mmHg·min for the $pH$-stat group. As ancillary analyses, we performed regressions of the $CO_2$ deficit index for each patient against his/her neuropsychologic change scores from preoperation to postoperation and follow up. For a single test, Visual Search Time, low $CO_2$ deficit index was significantly associated ($P = 0.008; r = 0.33$) with better neuropsychologic function at follow up. The high probability of a type I error makes interpretation of this result difficult. The fact that we did not come close to achieving the ideal index value of zero in the $pH$-stat group illustrates the practical difficulties of realizing the $pH$-stat condition by using blood gas sampling every 10 min as a guide.

I suggest that future studies investigating $P_{CO_2}$ during bypass should employ in-line blood gas monitoring and report the $CO_2$ deficit index as a measure of the results of $CO_2$ management and the depth and duration of hypothermia. A similar approach has recently been advocated for reporting other types of serial measurements in medical research.7

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<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Rectal (mmHg)</th>
<th>Esophageal (mmHg)</th>
<th>Arterial Tubing (mmHg)</th>
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<td>32.6</td>
<td>31.6 (4.19)</td>
<td>32.1 (4.89)</td>
</tr>
</tbody>
</table>

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