blood into the intrathecal space during spinal surgical interventions have dural punctures develop postdural puncture headache blood into a catheter under these circumstances may be ill advised; it is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrhage (12) but is even more likely to occur when blood is also found. Arachnoiditis has also been found after subarachnoid hemorrh age (12) but is even more likely to occur when blood is also found.
anesthetics (5), which was comparable to the incidence in our study (0.9/10,000).

Despite the limitations of our study that we have outlined above, we recommend that a minimum case load of 200 pediatric anesthetics per year is necessary to reduce the incidence of complications and improve the level of safety in pediatric practice.

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References

Continuous Intramucosal Pco₂ Measurement: Is It Actually Necessary?

To the Editor:

Knichwitz et al. (1) demonstrated the applicability of the fiberoptic Pco₂ sensor for the continuous measurement of intramucosal Pco₂ (Pico₂). The excellent precision and reliability of continuous measurement of Pico₂ using the method was promising, but its clinical significance is questioned. Pico₂ reflecting perfusion and/or metabolism in the mucosa changes rather slowly in the time course of hours or days even in critically ill patients (2). This makes the continuous measurement of Pico₂ actually unnecessary. Indeed, conventional tonometry requires 90 minutes for the equilibration of Pico₂, but it does not become a serious problem because of the slow changes of Pico₂. Another problem the authors raised is the instability of Pico₂ in the tonometric solution. It must be carefully assessed in evaluating intramucosal pH, but it can almost be overcome by the use of a phosphate-buffered solution instead of a saline tonometric solution (3).

Another issue of the method is the imbalance of its cost and benefit. The fiberoptic device as well as its disposable sensor are expensive, which renders its widespread use difficult. Gastric tonometry, which is quite simple and requires only a blood gas analyzer, can be performed everywhere with a low cost.

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References

In Response:

Tatara states that the continuous determination of Pico₂ is unnecessary and takes as basis for his opinion a review article by Fiddian-Green (1). In this review, Fiddian-Green describes the results of the important work on the physiology of intestinal ischemia by Haugland and colleagues (2) that observed: “the progression to transmural infarction occurs over a period of many hours or even days in patients who are critically ill.”

However, Tatara’s assumption that an increase in Pico₂ occurs parallel to the development of irreversible histologic damage that develops over hours to days is inappropriate. Pico₂ changes can actually happen long before the occurrence of irreversible tissue damage.

In recent experimental work (unpublished data), we saw that the reduction of mesenteric blood flow by 60% causes a sudden and rapid increase to 300-400% of baseline of the continuously measured Pico₂. This Pico₂ increase was completely reversible when inadequate perfusion was restored in due time and did not result in permanent tissue damage. However, after three hours of reduced mesenteric perfusion, the Pico₂ remained increased, indicating a permanent tissue injury. These results are in agreement with the reports of other authors, which demonstrate in animal models that changes in Pico₂, and the calculated pH occur immediately with the onset of mesenteric ischemia and not only after the occurrence of irreversible intestinal ischemic injury (3-5).

Therefore, it is this early increase in Pico₂ that allows the detection of inadequate tissue perfusion and, thus, the early therapy before irreversible damage. In conclusion, we cannot understand the denial of a new method for the continuous determination of Pico₂, before its clinical value has been tested and sufficient experience and data are available.

Apart from the advantage of a continuous determination, there are several other reasons underlying the importance of the fiberoptic CO₂ sensor. The conventional intermittent method via the nasogastric tonometer is an indirect method that has been associated with a number of methodological errors. Each blood gas analyzer has its own instrumental bias when measuring CO₂ in aqueous solutions. Therefore, every user has to establish individual correction factors according to the blood gas analyzer, the tonometric solution, and the equilibration time used. Only this will allow the comparison of collected data. A phosphate-buffered solution will, indeed, attenuate the enormous errors; however, it will not totally abolish the instrumental bias (6). Furthermore, the equilibration of CO₂ in the tonometric balloon is very slow and takes at least 60 minutes. In the clinical routine, Pico₂ and pH will not be determined every 60-90 minutes. As a result, the measured Pico₂ value can only be regarded as the average of a certain time period that does not pick up short time variations. Unintended Pico₂ alterations, due to hypoventilation or administration of bicarbonate, for example, will not be observed and, thus, not corrected for.

Finally, the conventional tonometry bears other causes for error, such as difficult handling with airfree instillation and aspiration of the tonometric fluid, the storage and processing of samples, and the calculation of Pico₂ data. As the continuous Pico₂ measurement determines the Pico₂ directly in the gastrointestinal lumen, these errors are eliminated, and the collected data can be directly compared with those of other patients in different critical care units. Only this will allow the introduction of normal Pico₂ range for the first time.

The gastrointestinal tract is thought to play a major role in the development of sepsis and multiorgan failure. Multiorgan failure is the most common cause of death in critical care patients. Its therapy is considered to be the foremost challenge of intensive care of this century’s last decade. The ability to detect gastrointestinal malperfusion in its early stages by continuous Pico₂ measurement will allow appropriate therapy and offer an interesting tool to eventually reduce mortality from multiorgan failure. This would clearly outweigh the costs of this new device.

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