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*In Reply:*—We appreciate very much the comments offered by Drs. Kao and Zavisca and Drs. Courtney and Bujor, who correctly emphasize the importance of temperature in the process of crystallization. While performing the studies described in our paper,<sup>1</sup> we also began studies dealing with the influence of temperature. Indeed, it appears that solutions that are kept in the refrigerator at 4° C have less visible precipitation. The complete studies comparing different pH changes at ambient (16–20° C) and low (4° C) temperature—by using count of particles and measurements of concentrations of bupivacaine, as previously described<sup>1</sup>—are still in progress. We believe that small differences of temperature that can be found between different operating rooms, as suggested by Drs. Kao and Zavisca, are not of major importance in the conditions of the already published paper<sup>1</sup> in which the minute amount of bicarbonate produced clinically insignificant differences of precipitation. On the other hand, when one studies solutions of bupivacaine for which large amounts of sodium bicarbonate produce significant changes of pH and precipitation,<sup>2</sup> the situation might be different. In these particular conditions, our preliminary results agree with the theoretical considerations of Drs. Kao and Zavisca, that the effect of temperature on crystallization will be more pronounced. This is shown in the results of studies dealing with solutions of 0.25% bupivacaine in which pH had been adjusted with 4.2% sodium bicarbonate (table 1). Finally, we also agree with the remarks of Drs. Courtney and Bujor who suggest that raising the temperature above ambient potentiates the crystallization. Moreover, we believe that epidural injection of alkalized bupivacaine will allow equilibration of the injectate with tissue temperature, *i.e.*, 37° C, and will promote precipitation. We are currently testing the hypothesis that “hot” alkalized bupivacaine might result in a “slow release effect” which might explain the increased

duration of the sensory block that we observed in a previous clinical study.<sup>2</sup>

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TABLE 1. Bupivacaine Concentrations (Gas Chromatography) (Mean  $\pm$  SD of Ten Measurements) and Count of Particles of Ten and Twenty-five Microns (Mean  $\pm$  SD of Five Measurements) and pH-adjustment

	0.25% Bupivacaine* 20° C	0.25% Bupivacaine* + 0.8 ml of 4.2% Sodium Bicarbonate 4° C†	0.25% Bupivacaine* + 0.8 ml of 4.2% Sodium Bicarbonate 20° C
pH	5.42 $\pm$ 0.03	7.47 $\pm$ 0.02‡	7.45 $\pm$ 0.02‡
Bupivacaine Concentration ( $\mu$ g/ml)	2.47 $\pm$ 0.01	2.46 $\pm$ 0.10	2.49 $\pm$ 0.03
Number of particles			
10 $\mu$	9.6 $\pm$ 1.4	7.5 $\pm$ 1.7	110.8 $\pm$ 27.7‡
25 $\mu$	0.3 $\pm$ 0.1	1.3 $\pm$ 0.5‡	27.3 $\pm$ 16.9‡

\* Bottles of 20 ml.

† Bottles of bupivacaine and bicarbonate were stored 48 h at 4° C before the study and were kept at the same controlled temperature

during 6 h after alkalization and before the measurements.

‡ Indicates  $P < 0.05$  versus before alkalization.

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### Axillary Block Utilizing the Pulse Oximeter

*To the Editor:*—We enjoyed reading the review article by Tremper and Barker describing the basic physics and technological evolution of pulse oximetry.<sup>1</sup> As mentioned in their paper, several clinical studies have used the pulse oximeter for nonoximetric purposes such as might be fulfilled by any similar plethysmographic device. Recently, we found yet another example of this role for the pulse oximeter as demonstrated by the following brief case example.

A 40-yr-old male patient, 3 weeks status post burns to the right arm and hand, was brought to the operating room for release of the median nerve at the right wrist under axillary block. A catheter was inserted into a vein in the left arm and fentanyl and midazolam were given for sedation. The patient was placed supine with right arm at 90° abduction, and the axillary area was prepped. However, due to the patient's bulky stature and the degree of scarring and induration secondary to burn

injury, the axillary artery could not be palpated. The pulse oximeter probe had been previously placed on one of the fingers of the patient's right hand and a good signal obtained. It was then noted that, when the axilla was palpated in the suspected anatomical vicinity of the artery, the oximeter signal would disappear. A 22-gauge needle was inserted at this point with subsequent elicitation of a satisfactory paresthesia. Following negative aspiration, a mixture of 30 cc of 0.75% bupivacaine with 1:200,000 epinephrine and 15 cc of 3% chloroprocaine was injected at this site. Adequate surgical anesthesia was obtained in the extremity within 15 min and lasted for the duration of the procedure. Since this initial case, we have utilized this technique in several other patients and have found it to be especially helpful in burned, obese, or very muscular individuals in whom landmarks are not easily found. Also, in a teaching setting, this maneuver allows the instructor to know with greater certainty whether the resident is indeed palpating the axillary artery with desired precision.

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### Video Display for Teaching Fiberoptic Intubations

*To The Editor:*—Fiberoptic intubation is increasing in popularity as one of the preferred methods to accomplish difficult intubations.

In experienced hands, a fiberoptic intubation can be accomplished easily and rapidly. However, teaching the technique to residents presents an unusual problem in that only the person actually manipulating the bronchoscope is able to visualize the anatomy. This results in the resident learning by trial and error rather than from instruction by the attending anesthesiologist. This inability to instruct and direct residents while performing the procedure results in resident frustration when the attending anesthesiologist "takes over" and accomplishes the intubation. We describe a method that allows more than one person to view the actual procedure while the resident is attempting the intubation.

The television camera commonly used during arthroscopic examinations easily attaches to the fiberoptic bronchoscope head. With proper adjustment of the television camera, orientation as to up and down is easily accomplished. During the intubation, both resident and attending anesthesiologist watch the television screen. The resident can then manipulate the bronchoscope with the attending anesthesiologist assisting in identification of structures and direction of movement. Our

fiberoptic scope is an Olympus® LF1 pediatric bronchoscope. The camera used is a Karl Storz® model 9000 the output of which is fed into a video cassette recorder and television set.

Before inserting the fiberoptic bronchoscope, it is essential to obtain proper spatial orientation. This is easily accomplished by pointing the scope at some small object or print and observing the television screen for up/down/left/right orientation. Once proper orientation has been achieved, it is important to "fix" the camera on the fiberoptic bronchoscope so the camera does not rotate.

A video tape recording of the technique is possible and the video tape recording can be used for teaching purposes when new residents are first introduced to fiberoptic intubations.

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### Pulse Oximeter Cost Per Use—Securing Savings

*To the Editor:*—Pulse oximetry has rapidly become a vital measurement for patients undergoing anesthesia and surgery. Our hospital adopted this new technology early in 1985 and quickly realized its clinical value; it took much longer to realize the associated supply costs.

With the initial acquisition of the Nellcor® N-100 by the hospital, each unit came to the department with a reusable clip-on sensor (DS-100A), about 35 units and reusable sensors in all. We experienced some sensor breakage; however, the reusable sensors disappeared from

the OR in about 4 months. Apparently, the reusable sensor was discarded by the clinical staff in favor of the disposable sensors which were initially estimated to last at least ten patient uses.

After reviewing the department's disposable sensor use in July of 1987, our annual usage figures indicated we were obtaining 4.9 patient uses per disposable sensor (25,440/5179) at an annual cost of \$69,490; it appeared that many disposable sensors were sent with patients from the OR to the ICU or thrown away after a few uses. A pilot program