

variation between patients. The difference in potency between morphine and meperidine seemed evident from the 1.8 difference in analgesic-demand. The number of injections seemed more important than the concentration. Thus, patient 05 with morphine 1 mg./ml. (0.04 mg./kg./6 hours) and patient 11 with morphine 0.1 mg./ml. (0.01 mg./kg./6 hours) averaged 2.5 and 2.4 injections/six hours, respectively. Patients with thoracic operations apparently had more pain than those with abdominal operations. Patient 04 (thoracic) received 67 injections within 48 hours (0.11 mg./kg./6 hours). On the other hand, patient 01 (abdominal) received one injection during the first hour but required no further analgesic. Most patients pressed more frequently early in the study as they emerged from the anesthetic and became aware of painful sensations. Then, as the pain decreased, the demand slackened. Peaks and troughs in analgesic-demand followed changes in pain as from an altered clinical situation. Thus, at first, patient 14 required 0.30-0.60 mg./kg./6 hours of meperidine, but with the beginning of a new pain, ischemic leg pain, the analgesic-demand increased to 1.35 mg./kg./6 hours. *Summary:* An analgesic-demand method for studying pain is described. Post-operative pain seems cyclical and varies considerably among subjects, but barring complications it is consistent within each subject. It apparently differs with site and type of operation. The analgesic-demand system is excellent for treatment of postoperative pain. Relief is usually achieved with relatively low total drug dosage.

Vasopressor Correction of Fetal Acidosis Following Spinal Hypotension. SOL M. SHNIDER, M.D., A. A. DELORMIER, M.D., J. W. HOLL, M.D., F. K. CHAPLER, M.D., and H. O. MORISHIMA, M.D., *University of California Medical Center, San Francisco, Calif.* Vasopressor correction of maternal hypotension during obstetrical spinal anesthesia has been criticized on the basis of associated uterine vasoconstriction and subsequent fetal hypoxia and acidosis. In the present study, maternal and fetal cardiovascular and acid-base changes resulting from spinal hypotension and vasopressor administration were ob-

served in eight pregnant ewes near term. *Method:* Under low spinal anesthesia, maternal femoral artery and fetal umbilical or carotid arteries were cannulated. After control values were obtained, high spinal anesthesia was performed which resulted in immediate maternal hypotension. A vasopressor (ephedrine sulfate) was administered to the ewes after varying periods of maternal hypotension. *Results: Control Period:* Control maternal arterial pressures and pulses varied between animals (100/70 to 170/125 mm. Hg and 80 to 150) but were stable in any one animal. Maternal arterial pH and base excess (B.E.) values were pH 7.38 to 7.48 and B.E. +1 to -4. Acid-base statuses five fetuses were normal (pH 7.31 to 7.45; B.E. -1 to -4); in the other three, metabolic acidosis was present (B.E. -8, -10, -12) and persisted throughout the control period. Fetal pulses ranged between 130 and 170/min. except in two of the acidotic fetuses which had heart rates of 180 and 220/min. *Spinal Hypotension:* Following high spinal anesthesia (T6 or higher), maternal pressure fell by 40 per cent of control values or more. In five ewes, Pa_{O_2} , Pa_{CO_2} , and base excess were unchanged during the hypotensive period. Hypoventilation and respiratory acidosis occurred in three ewes. Hypoxia was prevented or treated immediately by oxygen administration. Base excess was not altered in seven ewes. In one, however, mild metabolic acidosis was noted following transient hypoxia. During spinal hypotension Pa_{O_2} fell in all but one of the fetuses. Each fetus except one had an increase in Pa_{CO_2} , as well as a drop in B.E. Hypercapnia was greatest in the three fetuses whose mothers hypoventilated. Fetal distress (tachycardia and/or bradycardia) was present in all lambs during maternal hypotension. *Vasopressor Administration:* Ephedrine sulfate in a 25 mg. dose was administered intravenously to the ewes. After 9 to 160 minutes of maternal hypotension, maternal blood pressure returned to or above normal. Serial blood samples disclosed improvement of B.E., Pa_{CO_2} and Pa_{O_2} in seven lambs. When fetal acidosis was severe at the outset and/or prolonged in duration, complete correction was not seen. *Conclusion:* In the pregnant ewe, spinal anes-

this which was accompanied by maternal hypotension resulted in fetal acidosis. This acidosis had both a metabolic component and a respiratory component. The fetal deterioration was arrested and often corrected by administration of ephedrine sulfate to the mother.

An Improved Method for the Recognition of Atypical Plasma Cholinesterase. J. CUSPIN SMITH, PH.D., and FRANCIS F. FOLDES, M.D., *Division of Anesthesiology, Montefiore Hospital and Medical Center, Bronx, N. Y.* Determination of the dibucaine number (D.N.) has been recommended (Kalow, W., and Genest, K.: *Canad. J. Biochem.* 35: 399, 1957) for detection of the various genotypes of human plasma cholinesterase (PChE). The D.N. allows a clear-cut differentiation between normal (NN) and atypical (DD) homozygotes. The distinction between the NN and the heterozygote (ND), however, may be doubtful on occasions. Measurement of the relative rates of hydrolysis of benzoylcholine and acetylcholine (Rubinstein, H. M., and Dietz, A. A.: *J. Lab. Clin. Med.* 61: 979, 1963) also makes it possible to distinguish the NN from the DD genotype. The detection of the ND genotype, however, has no advantages over the dibucaine test. In attempting to develop a test that would make possible the unequivocal differentiation of the NN, ND, and DD genotypes we searched for a compound which, in contrast to hitherto-examined substrates (Davies, R. O., Marton, A. V., and Kalow, W.: *Canad. J. Biochem.* 38: 545, 1960), is hydrolyzed as fast or faster by the DD than by the NN enzyme. Tetracaine fulfilled this requirement. Because the relative hydrolysis rate of procaine by the DD genotype is the lowest of all substrates examined (Foldes, F. F., Foldes, V. M., Smith, J. C., and Zsigmond, E. K.: *ANESTHESIOLOGY* 24: 208, 1963) determination of the ratios of the hydrolysis rates of procaine and tetracaine seemed suitable for a clear-cut differentiation between the NN, ND and DD genotypes. The method developed on this premise consists of the ultraviolet spectrophotometric determination of the hydrolysis of 5×10^{-4} M. solutions of procaine at 290 $m\mu$. and tetracaine at 313 $m\mu$. by a modification of Kalow's

(*J. Pharmacol. Exp. Therap.* 104: 122, 1952) method. The mean rates and standard errors of the hydrolysis of procaine by NN (23 subjects), ND (24) and DD (18) plasmas were 1.06 ± 0.07 , 0.73 ± 0.06 and 0.16 ± 0.02 μ moles/ml. plasma/hour, respectively. The corresponding values for tetracaine were 0.29 ± 0.02 , 0.37 ± 0.02 and 0.38 ± 0.03 . The ratio of the hydrolysis rates of procaine and tetracaine multiplied by 100 (P/T ratio) revealed a highly significant difference between the NN, ND and DD groups. The means, and standard errors and ranges of the P/T ratios for the NN, ND and DD genotypes were 366 ± 8 (320–464), 196 ± 6 (152–239), and 40 ± 3 (16–59), respectively. There was no overlap of the P/T ratios of the three groups. The simple method described allows unambiguous identification of the three genotypes and for this reason is preferable to the method based on the determination of the D.N.

Hypoxemia in Shock and Myocardial Infarction: A Clinical Review. JAN D. SMITH, M.D., JEAN J. PENNINGCKX, M.D., and PETER SAFAR, M.D., *Department of Anesthesiology, University of Pittsburgh School of Medicine, Pittsburgh, Penna.* Patients admitted to the Intensive Care Unit during a 12-month period (1966/67), whose respiratory care was guided by arterial blood gas determinations, were reviewed. Pa_{O_2} , Pa_{CO_2} , pH and bicarbonate were determined (a) during spontaneous breathing of room air (when possible); (b) during spontaneous breathing of 100 per cent oxygen ($F_{I}O_2 = 1$) for 20 minutes; (c) during IPPV/ $F_{I}O_2 = 1$ (assisted respiration); and (d) during IPPV/ $F_{I}O_2 = 1$ (controlled ventilation). Positive-pressure ventilation was with large tidal volumes (approximately 15 ml./kg.), to determine the reversibility of the shunt effect ($D_{A}O_2$ with $F_{I}O_2 = 1$). In most patients sampling was via an arterial catheter left in place for periods as long as a week. In two patients V_D/V_T was calculated from the Bohr equation. **Results:** I. *Cardiogenic Shock without Pulmonary Edema* (13 patients). Three/13 survived. Measurements were made within one hour after onset of shock. pHa and bicarbonate indicated meta-