

## Biochemical Alterations during Tetany

L. J. DROP, M.D.\* AND E. V. MILLER, M.D.\*

Although tetanic manifestations of hypocalcemia may be relatively common in patients of the pediatric age group and in adults with acute hypoparathyroidism, their spontaneous occurrence during general anesthesia in patients without previously known abnormalities of calcium metabolism is rare. In fact, tetany was notably absent in critically ill patients with persistently low ionized calcium levels.<sup>1,2</sup>

In the case report presented below, we documented the changes in plasma ionized calcium concentration ( $[Ca^{++}]$ ) occurring with tetany in a patient both during anesthesia with spontaneous ventilation and in the awake state during controlled ventilation.

### REPORT OF A CASE

A 43-year-old woman was admitted to the hospital for removal of a hemangioma on the right side of the face. The history was unremarkable, and the patient denied the use of drugs and symptoms of abnormalities of calcium metabolism; specifically, there had not been symptoms of tetany in the past. Premedication consisted of diazepam, 10 mg, given orally. Anesthesia was induced by infusion of thiopental (175 mg, iv), and intubation of the trachea was performed following iv administration of succinylcholine. Anesthesia was maintained by spontaneous inhalation of halothane (1-1.5 per cent) in an oxygen-nitrous oxide (40:60) mixture, with occasional manual assistance. Approximately 90 min following onset of the procedure, when minute ventilation was considered adequate, tetanic position of both hands appeared. The wrists were flexed to a right angle and the fingers were flexed at the metacarpophalangeal joints. All digits were extended at the interphalangeal joints. The fingers and thumb were in adducted position. Chvostek's sign was readily elicited. Arterial blood pressure was 125/80 torr, pulse rate 84 beats/min, and respiratory rate 28/min. Laboratory analysis of a specimen of arterial blood withdrawn at this time revealed  $P_{H_2}$  131 torr,  $P_{CO_2}$  29 torr,  $pH$  7.48, and ionized calcium concentration ( $[Ca^{++}]$ ), 0.66 mM. Calcium chloride (5 mg/kg) was administered intravenously over a 3-min period and the tetanic manifestations disappeared. The surgical procedure was completed and administration of anesthetic drugs discontinued. Postoperative recovery was uncomplicated. Three days later, after informed consent had been obtained, a 21-gauge thin-walled needle was advanced into the left radial artery for blood sampling. An intravenous infusion of 5 per cent dextrose in water was started and a blood pressure cuff applied. The patient, fully awake and alert, was then hyper-

ventilated manually via face mask (room air) for a 30-min period, after which tetanic manifestations in both hands appeared. Chvostek's sign was readily elicited. Spontaneous ventilation was then allowed to occur, initially with occasional assistance. Arterial blood samples were withdrawn and the patient tested for both Chvostek's sign and Trousseau's sign, prior to onset and upon cessation of hyperventilation, and at 5-min intervals until 15 min and 30 min following onset of spontaneous ventilation.

As shown in table 1, tetanic manifestations were associated with decreased  $[Ca^{++}]$ , increased  $pH$ , and decreased  $P_{CO_2}$ . The decrease in  $[Ca^{++}]$  was more pronounced during anesthesia, despite a smaller  $pH$  change when compared with the period of hyperventilation in the awake state.  $[Ca^{++}]$  gradually returned to the control level and both Trousseau's and Chvostek's signs could not be elicited 30 min following cessation of hyperventilation. Blood gases,  $pH$ , and ionized calcium concentration were measured using appropriate electrodes at 37°C (Radiometer® electrodes with PHM 72 digital meter and Orion® S-S 20 calcium-selective electrode system, respectively).

### DISCUSSION

Our case report demonstrates that tetany may be associated with ionized hypocalcemia, alkalosis, or both. We found that symptoms of tetany were present over a relatively wide range of ionized calcium values. In our patient, tetany first appeared spontaneously during surgical anesthesia with halothane when  $[Ca^{++}]$  was substantially below normal ( $1.12 \pm 0.03$  mM).<sup>3</sup> The reason for this degree of hypocalcemia is not immediately apparent, although a slightly decreased  $P_{CO_2}$  and increased  $pH$  may have been among the contributing factors. However, similar blood-gas values and  $pH$  may be regularly recorded during anesthesia in other patients without symptoms of tetany. Total calcium concentration measurement was not available for our patient. However, such information would not have added much to our observation, since a substantial decrease in the ionized moiety can occur without a change in total calcium concentration.<sup>1</sup> The electrocardiogram was monitored with oscilloscopic display, limiting our ability to determine corrected values of the Q-T interval ( $Q-T_c$  and  $Q-T_{c'}$ ). If a direct-writing electrocardiograph had been available, estimation of directional changes in  $[Ca^{++}]$  might have been possible by evaluation of the duration of Q-T intervals. However, in view of recent data from this laboratory,<sup>4</sup> precise determination of  $[Ca^{++}]$  status requires direct laboratory analysis.

Edmondson and co-workers<sup>5</sup> found, in the experi-

\* Assistant Professor of Anaesthesia, Harvard Medical School at the Massachusetts General Hospital.

Received from the Anesthesia Services, Massachusetts General Hospital and the Department of Anaesthesia, Harvard Medical School, Boston, Massachusetts 02114. Accepted for publication June 17, 1979. Supported in part by NIGMS Grant GM 15904-07.

Address reprint requests to Dr. Drop.

TABLE 1. Biochemical Values and Clinical Signs in a Patient with Tetany

	P <sub>O<sub>2</sub></sub> (torr)	P <sub>CO<sub>2</sub></sub> (torr)	pH	[Ca <sup>++</sup> ] (mM)	Chvostek's Sign	Trousseau's Sign
During anesthesia	131	29	7.47	0.66	+	+
Awake						
Control (spontaneous ventilation)	98	37	7.44	0.92	—	—
After 30 min of hyperventilation	95	20	7.65	0.77	+	+
Spontaneous ventilation						
5 min	93	28	7.53	0.78	+	+
10 min	96	34	7.47	0.80	+	+
15 min	96	37	7.45	0.86	+	—
30 min	98	39	7.41	0.93	—	—

mental animal, that hypocalcemia and alkalosis in the extracellular fluid acted synergistically in the etiology of tetany. Previous data from this laboratory<sup>3</sup> are in agreement with results of these investigators, who pointed out that the magnitude of reduction in [Ca<sup>++</sup>] due to alkalosis *per se* is relatively small, and that alkalosis-induced tetany cannot be explained by the hypocalcemic effect of alkalosis alone. They<sup>5</sup> also found that hypocalcemia in combination with alkalosis consistently induced tetany, whereas either condition alone did not.

In our patient, arterial blood pressure was well-maintained throughout the hypocalcemic episode. Alterations in both ventricular and peripheral vascular function can occur with hypocalcemia.<sup>6</sup> When tetany appeared in our patient during anesthesia, calcium chloride was administered, and tetanic manifestations disappeared. In view of the relatively small [Ca<sup>++</sup>] change that occurred with tetany in the awake state, calcium replacement therapy was not considered necessary.

The authors express their gratitude to Mr. D. R. Misiano for his expert assistance.

## REFERENCES

1. Drop LJ, Laver MB: Low plasma ionized calcium and response to calcium therapy in critically ill man. *ANESTHESIOLOGY* 43:300-306, 1975
2. Taylor B, Sibbald WJ, Edmonds MW, et al: Ionized hypocalcemia in critically ill patients with sepsis. *Can J Surg* 21:429-433, 1978
3. Drop LJ, Fuchs C, Stulz PM: Determination of blood ionized calcium in a large segment of the normal adult population. *Clin Chim Acta* 89:503-510, 1978
4. Scheidegger D, Drop LJ: The relationship between duration of Q-T interval and plasma ionized calcium concentration: Experiments with acute, steady-state [Ca<sup>++</sup>] changes in the dog. *ANESTHESIOLOGY* 51:143-148, 1979
5. Edmondson JW, Brashear RE, Li TK: Tetany: Quantitative interrelationships between calcium and alkalosis. *Am J Physiol* 228:1082-1086, 1976
6. Stulz PM, Scheidegger D, Drop LJ, et al: Ventricular pump performance during hypocalcemia. *J Thorac Cardiovasc Surg* 78:185-194, 1979

Anesthesiology  
52:83-86, 1980

## Cardiorespiratory and Cranial-nerve Sequelae of Surgical Procedures Involving the Posterior Fossa

ALAN A. ARTRU, M.D.,\* ROY F. CUCCHIARA, M.D.,† JOSEPH M. MESSICK, M.D.‡

Surgical procedures in the region of the posterior fossa are attended by a variety of potential complica-

tions. Certain of these—venous air embolism, for example—are relatively common, and have received investigative attention. Other less frequent complications have received less attention. The following case report illustrates some problems that may attend neurosurgical procedures involving the posterior fossa.

## REPORT OF A CASE

An 18-year-old male patient was scheduled for posterior-fossa exploration for a cerebellar mass lesion with associated hydro-

\* Fellow in Anesthesiology.

† Assistant Professor of Anesthesiology.

‡ Associate Professor of Anesthesiology.

Received from the Department of Anesthesiology, Mayo Medical School and Mayo Clinic, Rochester, Minnesota. Accepted for publication July 6, 1979.

Address reprint requests to Dr. Artru: Department of Anesthesiology, Mayo Clinic, 200 First Street, S. W., Rochester, Minnesota 55901.