

Hosking cites the study by Yokoyama *et al.*<sup>12</sup> as evidence that calcium administration enhances myocardial performance. Yokoyama and his colleagues decreased the ionized calcium concentration to less than 50% of the normal control value (far less than the concentrations we measured immediately prior to separation from bypass) before administering calcium salts. Toxic hypocalcemia may lead to impaired myocardial performance amenable to improvement by administration of calcium salt.<sup>13</sup> We do not believe that the study by Yokoyama *et al.* offers evidence that calcium salts may be safely and efficaciously administered to nearly-normocalcemic patients emerging from extracorporeal perfusion. A more recent study from the same group confirms the deleterious effects of calcium after ischemia.<sup>14</sup>

Hosking asserts that "it seems logical to achieve normocalcemia prior to separation from bypass before administering catecholamines whose mechanism of action involves enhanced intracellular transport of calcium." We know of no data supporting a reduced efficacy of catecholamines in moderately hypocalcemic patients. Indeed, we have recently observed that moderately hypocalcemic patients respond normally to epinephrine at the time of separation from cardiopulmonary bypass.<sup>5</sup> In current studies in our laboratory, we have measured no reduction in the ability of epinephrine to stimulate cyclic AMP production until ionized calcium concentrations decrease to less than 0.5 mM. However, we have measured reductions in the efficacy of inotropic agents following calcium administration *in vitro* (studies in progress), in whole animals,<sup>15,16</sup> and in patients.<sup>4,6</sup>

In summary, we stand by our conclusions that calcium salts lack efficacy at increasing cardiac output and that their routine administration be avoided in the reperfused, ischemic heart. Until outcome studies demonstrate that routine calcium administration is a safe practice, we will reserve calcium administration for those patients with specific indications.

JOHN F. BUTTERWORTH IV, M.D.

Associate Professor

ROGER L. ROYSTER, M.D.

Associate Professor

RICHARD C. PRIELIPP, M.D.

Assistant Professor

GARY P. ZALOGA, M.D.

Professor

Department of Anesthesia

Wake Forest University Medical Center

Medical Center Boulevard

Winston-Salem, North Carolina 27157-1009

#### REFERENCES

1. Robertie PG, Butterworth JF IV, Royster RL, Prielipp RC, Dudas L, Black KW, Cole LR, Zaloga GP: Normal parathyroid hormone responses to hypocalcemia during cardiopulmonary bypass. *ANESTHESIOLOGY* 75:43-48, 1991
2. Malcolm DS, Zaloga GP, Holaday JW: Calcium administration increases the mortality of endotoxic shock in rats. *Crit Care Med* 17:900-903, 1989
3. Butterworth JF IV, Strickland RA, Mark LJ, Kon ND, Zaloga GP: Calcium does not augment phenylephrine's hypertensive effects. *Crit Care Med* 18:603-606, 1990
4. Zaloga GP, Strickland RA, Butterworth JF IV, Mark LJ, Mills SA, Lake CR: Calcium attenuates epinephrine's beta-adrenergic effects in postoperative heart surgery patients. *Circulation* 81:196-200, 1990
5. Royster RL, Butterworth JF IV, Prielipp RC, Robertie PG, Kon ND, Tucker WY, Dudas LM, Zaloga GP: A randomized, blinded, placebo-controlled evaluation of calcium chloride and epinephrine following emergence from cardiopulmonary bypass. *Anesth Analg*, in press
6. Butterworth JF IV, Zaloga GP, Prielipp RC, Tucker WY Jr, Royster RL: Calcium inhibits the cardiac stimulating properties of dobutamine but not amrinone. *Chest* in press
7. Opie LH: Reperfusion injury and its pharmacologic modification. *Circulation* 80:1049-1062, 1989
8. Castillo CF-D, Harringer W, Warshaw AL, Vlahakes GJ, Koski G, Zaslavsky AM, Rattner DW: Risk factors for pancreatic cellular injury after cardiopulmonary bypass. *N Engl J Med* 325:382-382, 1991
9. Levy MN: Role of calcium in arrhythmogenesis. *Circulation* 80:IV23-IV30, 1989
10. Surawicz B, MacDonald MG, Kaljot V, Bettinger JC, Carpenter AA, Korson L, Starcheska YK: Treatment of cardiac arrhythmias with salts of ethylenediamine tetraacetic acid (EDTA). *Am Heart J* 58:493-503, 1959
11. Smith RC, Leung JM, Mangano DT, SPI Research Group: Postoperative myocardial ischemia in patients undergoing coronary artery bypass graft surgery. *ANESTHESIOLOGY* 74:464-473, 1991
12. Yokoyama H, Julian JS, Vinten-Johansen J, Johnston WE, Smith TD, McGee DS, Cordell AR: Postischemic  $[Ca^{++}]$  repletion improves cardiac performance without altering oxygen demands. *Ann Thorac Surg* 49:894-902, 1990
13. Drop LJ, Geffin GA, O'Keefe DD, Newell JB, Jacobs ML, Fowler BN, Daggett WM: Relation between ionized calcium concentration and ventricular pump performance in the dog under hemodynamically controlled conditions. *Am J Cardiol* 47:1041-1051, 1981
14. Tefer DK, Nakanishi K, Johnston WE, Vinten-Johansen J: Transient regional hypocalcemia during the initial phase of reperfusion does not reduce myocardial necrosis (abstract). *FASEB J* 5:A1048, 1991
15. Zaloga GP, Willey S, Malcolm D, Chernow B, Holaday JW: Hypercalcemia attenuates blood pressure response to epinephrine. *J Pharmacol Exp Ther* 247:949-952, 1988
16. Prielipp RC, Hill T, Washburn D, Zaloga GP: Circulating calcium modulates adrenaline induced cyclic adenosine monophosphate production. *Cardiovasc Res* 23:838-841, 1989

(Accepted for publication August 27, 1991.)

#### Postintubation Croup in Children

To the Editor:—Postintubation croup is a commonly cited problem occurring in healthy children after anesthesia. A prospective study by

Koka, et al,<sup>1</sup> demonstrated an overall incidence of 1% and identified several factors that were positively correlated with the occurrence of

postintubation croup. In their study, the diagnosis of postintubation croup was made in any child who developed hoarseness, stridor, and/or retractions postoperatively. It was not made clear whether any of these children had surgical procedures involving the upper airway, such as laryngoscopy, bronchoscopy, or laryngeal surgery. The authors did, however, note that the incidence of postoperative croup was not increased in patients undergoing operations of the head and neck. In addition, at the time of their report, endotracheal tubes were not subject to current standards and may have been cleaned and reused, and, therefore, more irritating to the airway.

In an attempt to further define the incidence and predictive factors contributing to postintubation croup in healthy children undergoing anesthesia, we undertook a prospective study between August 1990 and June 1991, collecting data on all children who fulfilled our definition of postintubation croup in the postanesthesia care unit. We defined postintubation croup as inspiratory stridor associated with retraction of accessory muscles of respiration of at least 30 min duration and severe enough to warrant therapy either with humidified oxygen under a mist tent and/or nebulized racemic epinephrine. We excluded from study any child with preexisting airway disease and any child undergoing procedures involving surgical instrumentation of the upper airway.

Over the 10-month study period, 5,589 patients had endotracheal tubes placed for administration of anesthesia. This represents 63% of all children anesthetized during that period. Of these patients, only 7 children fulfilled our criteria for postintubation croup, for an incidence of 0.1%. The ages of these children ranged from 7 months to 9 yr. Four of the 7 children had a prior history of croup either with a viral illness or after previous intubation. None of the children had croup severe enough to warrant treatment with nebulized racemic epinephrine, and no day-surgery patient with postintubation croup had to remain overnight for observation. Because of the extremely small percentage of children who developed postintubation croup, no attempt was made to predict causative factors by comparison with a control group.

Anesthesiology  
75:1123-1124, 1991

## Transparent Dressing Is Useful for the Secure Fixation of the Endotracheal Tube

*To the Editor:*—Accidental tracheal extubation during head and neck surgery in pediatric patients may result when the patient's head is repositioned or because the disinfectant used as part of the surgical preparation reduces the adhesive strength of the tape used to secure the endotracheal tube. We propose the use of sterile polyurethane transparent dressing. After securing the endotracheal tube with adhesive tape, we also apply transparent dressing (Tegaderm® 1626, 3M Medical Products Division, MN) on the skin (fig. 1). We have successfully used this technique without any complications to secure the reinforced silicone rubber endotracheal tube in more than 1,000 cases, including infants, of head, facial, dental, and neck surgery and neurosurgery. This technique possibly may be applied to even neonates. Finally, we believe that the cost for transparent dressing (\$1.79 per one piece of Tegaderm® in the United States) is a small price to pay for the added reassurance that extubation, which could result in life-threatening complications, will not occur during these surgical procedures.

At our institution the general practice is that all children initially have age-appropriate endotracheal tubes placed, calculated as  $(16 + \text{age})/4$  for children over 2 yr of age and at the discretion of the anesthesiologist for patients less than 2 yr of age. If this results in an air leak at or greater than 40 cm H<sub>2</sub>O, the tube is replaced with the next smallest size.

In summary, our prospective observation of more than 5,000 patients found the incidence of postintubation croup to be 0.1%, far less than previously reported. The present use of standardized nonreactive endotracheal tubes and the practice of assuring that an air leak is present around the endotracheal tube may be important factors in minimizing the occurrence of postintubation croup.

RONALD S. LITMAN, D.O.\*

*Fellow*

THOMAS P. KEON, M.D.

*Senior Anesthesiologist*

*Department of Anesthesiology and Critical Care Medicine  
The Children's Hospital of Philadelphia  
34th Street and Civic Center Boulevard  
Philadelphia, Pennsylvania 19104*

*\*Present Address:*

*Department of Anesthesiology  
University of Rochester Medical Center  
601 Elmwood Avenue  
Rochester, New York 14642*

## REFERENCES

1. Koka BV, Jeon IS, Andre JM, MacKay I, Smith RM. Postintubation croup in children. *Anesth Analg* 56:501-505, 1977

*(Accepted for publication August 29, 1991.)*



FIG. 1. Fixation of reinforced silicone endotracheal tube by the combination of adhesive tape and transparent dressing (Tegaderm®) in a young child undergoing otologic surgery.