

# Electrogastrographic Changes in Children Who Undergo Day-Surgery Anesthesia

By Wei Cheng, Bernadette Chow, and Paul K.H. Tam  
Hong Kong

**Background/Purpose:** Postoperative nausea and vomiting is common after general anesthesia. The timing of resuming oral input is arbitrary. This study aims to estimate the duration of emetic effects of general anesthesia after day surgery in children with electrogastrography (EGG).

**Methods:** Children between the age of 3 and 12 years undergoing elective nonabdominal surgery were recruited. The standard anesthesia protocol of thiopentone (5 mg/kg), O<sub>2</sub> (30%), N<sub>2</sub>O (70%), and isoflurane (1.5%) was adopted. Caudal block was applied to the patients. A laryngeal mask was used. A mobile electrogastrogram (EGG) machine (Synectic; International Medtronic Synectics, Stockholm, Sweden) was attached to the epigastrium of the patient at least 1 hour before the operation and the recording continued through the operation and for a further 2 hours after the operation. The first half hour of preoperative recording was taken as normal control period. The results were analyzed using paired ttest.

**Results:** Twenty patients who underwent circumcision under general anesthesia were studied. The mean age was 6.6

years. The mean anesthetic duration was 33.2 min. The tachygastric component (associated with nausea and vomiting) became prominent immediately after induction and returned to normal 1 half hour after cessation of general anesthesia. The dominant frequency instability coefficient of EGG (DFIC) and the dominant power instability coefficient (DPIC) peaked during the first half hour period postoperatively and returned to baseline 1 hour postoperatively (DPIC,  $P > .05$ ). Bradygastric became prominent during the periods 1 half-hour before and 1 half-hour after the general anesthesia and returned to baseline 1 hour postoperatively ( $P < .05$ ).

**Conclusions:** Significant EGG changes occur during day-surgery general anesthesia for children undergoing nonabdominal surgery. These changes return to baseline 1 hour after reversal of anesthesia. It is probably safe to restart feeding 1 hour later after day-surgery general anesthesia without causing nausea and vomiting.

*J Pediatr Surg* 34:1336-1338. Copyright © 1999 by W.B. Saunders Company.

INDEX WORDS: Electrogastrography, postoperative nausea.

**P**OSTOPERATIVE NAUSEA and vomiting are the well-documented complications of general anesthesia. As a consequence, resumption of eating is postponed until the effect of the anesthetic agents wears off. With the advent of day surgery, the patients are discharged much earlier than before. The timing of resumption of eating is ill defined. In children, the subjective feeling of nausea is difficult to evaluate. Electric activity of stomach correlates well clinically with nausea and vomiting. The aim of this study is to record the electrogastrographic changes in children who undergo general anesthesia for day surgery and determine the timing of recovery of normal gastric electric activity.

*From the Division of Paediatric Surgery, Department of Surgery, The Hong Kong University Medical Centre, Queen Mary Hospital, and the Department of Anesthesia, The Duchess of Kent Children's Hospital, Hong Kong.*

*Address reprint requests to Professor Paul K.H. Tam, Division of Paediatric Surgery, Department of Surgery, The Hong Kong University Medical Centre, Queen Mary Hospital, Pok Fu Lam Rd, Hong Kong.*

*Copyright © 1999 by W.B. Saunders Company  
0022-3468/99/3409-0007\$03.00/0*

## MATERIALS AND METHODS

Children between 3 to 12 years of age admitted into a single institution who underwent circumcision were recruited. Only patients with anesthetic risk scale of 1 or 2 (ASA) were studied. No premedication was given except for local anesthetic cream at the drip site. The standard anesthesia of thiopentone (5 mg/kg), O<sub>2</sub> (30%), N<sub>2</sub>O (70%), and isoflurane (1.5%) were instituted. The patient also received caudal block consisting of Marcaine. Laryngeal mask was applied. No prophylactic antiemetic was given. Postoperatively, analgesia consisted of syrup paracetamol (10 to 20 mg/kg). Circumcision was performed by a single surgeon using standard technique for pediatric circumcision.

The patients fasted for 4 hours preoperatively. Mobile electrogastrography machine (Synectic) with 2 active electrodes and 1 reference electrode was applied to the epigastrium of each patient 1 hour before the operation in the ward. The first half hour of recording (preoperatively) was adopted as the baseline control. The recording continued throughout the operation and for 2 hours postoperatively. The data were uploaded on to a personal computer and the data analyzed. The preoperative and postoperative EGG recording was segmented into half-hour periods and analyzed. The intraoperative recording was analyzed as a single entity. Symptoms of nausea, vomiting, and pain were observed and recorded throughout the recording period.

Normal EGG frequency is defined as 2.4 to 3.7 cycles per minute. Tachygastric is defined as gastric electric frequency of 3.7 to 9 cycles per minute, whereas bradygastric is defined as frequency between 0.5 to 2.4 cycles per minute. The percentages of normal frequency, bradygastric, tachygastric, and duodenal or respiratory frequency in a given period were computed. The data analysis is based on the running

spectrum analysis or running Fast Fourier Transform (FFT) analysis. The dominant frequency instability coefficient (DFIC) was computed by dividing the standard deviation of the dominant frequencies by the mean of the dominant frequencies for the period in question. Dominant power instability coefficient (DPIC) was computed by dividing the standard deviation of the dominant frequency powers by the mean of the dominant frequency powers. Period dominant frequency (PDF) and period dominant power (PDP) were calculated from the mean FFT lines for a given period. The data were analyzed with paired *t* test (SPSS) and *P* less than .05 was considered statistically significant.

RESULTS

Twenty boys underwent the study. The mean age was 6.6 years (range, 3.5 to 8 years). The mean anesthetic time was 33.2 minutes (range, 22 to 45 minutes).

One patient experienced laryngo spasm during induction. The EGG tracing during the period did not show any abnormality. One patient experienced nausea without vomiting on three occasions during the first postoperative hour (5%). Compared with the baseline, EGG recording showed reduction in normal rhythm and increase in both tachygastria (from 0% to 9%) and bradygastria (from 18% to 63%).

In the first half-hour period postoperatively, compared with the baseline period, there was a significant reduction in percentage of normal EGG in the immediate postoperatively period (*P* = .034). This was mirrored by significant increase in bradygastria (*P* = .039; Fig 1). There also was a simultaneous increase in tachygastria, although this failed to reach statistical significance. The dominant frequency instability coefficient and the dominant power instability coefficient (DFIC and DPIC) both peaked during the first half-hour period postoperatively and returned to normal 1 hour postoperatively (*P* = .15 and .026, respectively; Fig 2). With exception of the power (PDP), all these changes (percentages of normal and bradygastria, DPIC) returned to normal in the next half hour. There was a noticeable increase in the percent-

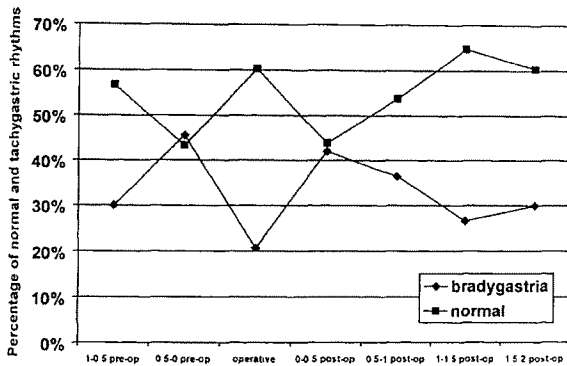


Fig 1. The percentages of normal gastric rhythm and bradygastria before, during, and after general anesthesia in children.

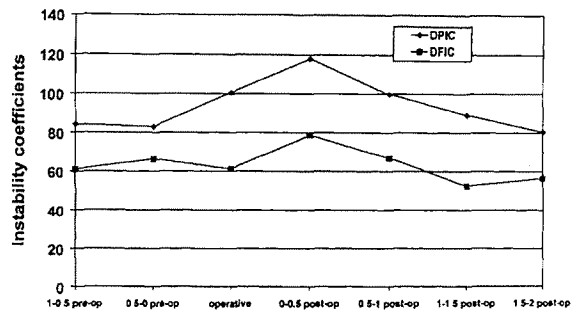


Fig 2. The dominant power instability coefficient (DPIC) and dominant frequency instability coefficient (DFIC) before, during and after general anesthesia in children undergoing day surgery.

age of tachygastria 1 half hour postoperatively, although the change failed to reach statistical significance (Fig 3).

After analysis of the findings of the first 16 patients, it was felt that it would be safe to start feeding 1 hour after general anesthesia when EGG changes normalize. All 4 children on such a regimen tolerated the feeding well.

DISCUSSION

Postoperative Nausea and Vomiting

The incidence of postoperative nausea and vomiting in recent studies is between 20% and 30%.<sup>1</sup> The incidence is higher in pediatric patients compared with adults. The mechanism of emesis is thought to be controlled by a center located at parvicellular reticular formation, situated in the lateral reticular formation close to the tractus solitarius in the brainstem. Stimuli from gastrointestinal tract, chemoreceptor trigger zone in the area postrema, cortex (psychological), and vestibule of inner ear converge onto this center. Nitrous oxide, an odorless and colorless anesthetic drug, causes nausea and vomiting postoperatively in about 15% of patients. It is predominantly eliminated as such in the expired gas.<sup>2</sup> Thiopental, a barbiturate, has a very short plasma half-life of 3 minutes. Isoflurane, an inhalational anesthetic agent, also produces nausea and vomiting in 3% to 15% of patients.

The sensation of nausea is subjective. Children may

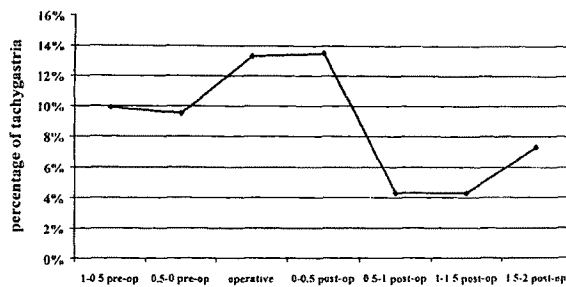


Fig 3. Percentage of tachygastria before, during, and after general anesthesia.

have difficulty verbalizing this feeling. The timing of resumption of oral intake in clinical practice is based on one's experience rather than scientific measurement. In current practice of day surgery, patients are encouraged to resume normal activity as soon as possible. The question of when to resume eating, therefore, has become an important pertinent issue. EGG provides an objective and noninvasive measure of the activity of the end organ of vomiting, stomach.

#### *Electrogastrography in Monitoring Gastric Activity*

The stomach has regular electrical activity, controlled by the pacemaker along the greater curvature. Mechanical gastric contraction occurs only during the electrical activity (spike potential). The electrical activity is a good indicator of gastric mechanical activity, and, hence, it is best suited for monitoring.<sup>3</sup> With the advent of portable surface EGG, the monitoring can be performed in operating theater. The procedure of recording is simple, not dissimilar to that of electrocardiogram and is well accepted by the patients.

The baseline measurement of this relatively uniform group of healthy Chinese boys during the fasting stage represents normal EGG findings of boys of this age group. The EGG tracing showed that on average bradygastria accounted for about 30% of rhythm during fasting state. This appears to be more than the adult recording. Study has shown that EGG changes with age. Neonates and infants have more unstable EGG findings than adults.

How much of the bradygastria is caused by movement artifact is unclear, although during the first half hour postoperatively, the high percentage of bradygastria was recorded when the child was relatively motionless. Bradygastria is associated with antral hypomotility and slow gastric emptying.<sup>4</sup> Intraarterial infusion of adrenaline also induces bradygastria.<sup>5</sup> The increase of percentage of bradygastria just before the operation may be caused by anxiety when the child was transferred to the operating theater. The bradygastria recorded immediately after the operation may be related to sympathetic overflow secondary to pain experienced postoperatively or anxiety.

The fluctuation of both DFIC and DPIC followed the similar pattern, ie, both peaked immediately postoperatively. The first half hour postoperatively appeared to be the period in which both EGG frequency and power were most unstable. The pattern normalized about 1 hour later. These instabilities seem to be initiated by general anesthesia, become most prominent immediately after waking up, and settle in an hour. It is reasonable to assume that one should wait until the instabilities subside before resuming feeding. The last four children in this series who were put on feeding 1 hour after general anesthesia tolerated the regimen well.

The percentage of tachygastria, which is associated with nausea and vomiting, increased during the operation and stayed high during the first half hour postoperatively. Although the degree of change failed to reach statistical significance, the pattern may signify the tendency of vomiting during the periods. One child with dysrhythmia in the first half hour postoperatively experienced nausea despite fasting. It is likely that feeding during this period may provoke more frequent and more severe degree of nausea and vomiting, and, therefore, attempts at too-early feeding, ie, within the first half hour postoperatively should be avoided.

This study has concentrated on a uniform group of day-case surgery patients undergoing circumcision and skin lesion excision. The findings may be similar for patients undergoing procedures such as inguinal herniotomy, orchidopexy and umbilical herniorrhaphy but also may be different because traction of peritoneum is involved. Our initial results on 3 patients (not included in this series) who had inguinal herniotomy did not show any difference from those having circumcision. Further studies will be required to confirm these findings in patients undergoing different types of day-case surgical procedures.

The constellation of EGG changes encountered in this study and, more importantly, the duration of these transient changes demonstrated for the first time the effect of a given protocol of general anaesthesia on gastric electrical activity. The findings imply that gastric electrical activity returns to normal 1 hour after reversal of day-surgery general anesthesia in children undergoing nonabdominal surgery. Food intake may be started thereafter.

#### ACKNOWLEDGMENT

The authors thank East Kowloon Rotary Club for donating the mobile electrogastrography machine (Synectics) for service and research.

#### REFERENCES

1. Watch MF, White FF: Postoperative nausea and vomiting: Its etiology, treatment and prevention. *Anaesthesiology* 77:162-184, 1992
2. Marshal BE, Longnecker DE: General anesthetics, in Goodman Gilman A, Rall TW, Nies AS, et al (eds): *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. Tarrytown, NY, Pergamon Press, Inc. 1990 pp 285-310
3. Cheng W, Milla P, Spitz P: Surface electrogastrographies in children with esophageal atresia. *Pediatr Surg Int* 12:552-555, 1997
4. Bortolotti M, Sarti P, Barara L, et al: Gastric myoelectric activity in patients with chronic idiopathic gastroparesis. *J Gastrointest Mot* 2:104-108, 1990
5. You CH, Chey WY: Study of electromechanical activity of the stomach in humans and in dogs with particular attention to tachygastria. *Gastroenterology* 86:1460-1468, 1984