Intravenous atropine treatment in infantile hypertrophic pyloric stenosis

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Aims: To assess the efficacy of a new regimen of intravenous atropine treatment for infantile hypertrophic pyloric stenosis (IHPS) with special reference to regression of pyloric hypertrophy.

Methods: Atropine was given intravenously at a dose of 0.01 mg/kg six times a day before feeding in 19 infants with IHPS diagnosed from radiographic and ultrasonographic findings. When vomiting ceased and the infants were able to ingest 150 ml/kg/day formula after stepwise increases in feeding volume, they were given 0.02 mg/kg atropine six times a day orally and the dose was decreased stepwise.

Results: Of the 19 infants, 17 (89%) ceased projectile vomiting after treatment with intravenous (median seven days) and subsequent oral (median 44 days) atropine administration. The remaining two infants required surgery. No significant complications were encountered. Ultrasonography showed a significant (p < 0.05) decrease in pyloric muscle thickness, but no significant shortening of the pyloric canal after completion of the atropine treatment. The patients exhibited failure to thrive at presentation, but were thriving at 6 months of age (p < 0.01).

Conclusions: This atropine therapy resulted in satisfactory clinical recovery. Pyloric muscle thickness was significantly reduced.

Fredet-Ramstedt pyloromyotomy has been regarded as the optimal treatment for infantile hypertrophic pyloric stenosis (IHPS), although surgical complications have been reported. Medical treatment with oral antispasmodics such as atropine sulphate or methyl scopolamine nitrate have virtually been abandoned since the mid-1960s. Oral atropine has not worked consistently in infants with frequent projectile vomiting unless given at a high dose. Recently, medical treatment with atropine has been reappraised as an option for IHPS. Nagita et al. have reported a high success rate using intravenous atropine treatment. In their regimen, the intravenous dose of atropine was increased stepwise until vomiting was controlled, so the final dose administered varied between patients. We devised a new regimen with a fixed dose of atropine. This study was designed to assess the clinical outcome of our regimen and to look for evidence of regression of pyloric hypertrophy using ultrasonography.

PATIENTS AND METHODS

Patients

Ethical approval was obtained from the departmental committee, and informed consent was obtained from the patients’ guardians. The study population consisted of 19 consecutive infants (male/female 16:3) with IHPS, who were in Osaka Medical Centre and Research Institute for Maternal and Child Health in the period November 1996 to March 1998. All fulfilled the following diagnostic criteria for IHPS:

(a) repeated projectile vomiting more than twice a day;
(b) gastric outlet obstruction and characteristic narrow, long pyloric canal on upper gastrointestinal series;
(c) pyloric canal length ≥ 15 mm and pyloric muscle thickening ≥ 4 mm on ultrasonography.

Table 1 shows the patient characteristics. The median (range) age was 40 (22–85) days at admission. Their median (range) weights at birth and admission were 3086 (2480–4430) g and 3970 (3200–5410) g respectively.

Treatment regimen

Atropine was administered intravenously at a dose of 0.01 mg/kg six times a day five minutes before feeding. During atropine infusion, the heart rate was continuously monitored by electrocardiography. Oral feeding was started at a volume of 10 ml formula, six times a day. The volume was increased day by day until patients tolerated 150 ml/kg/day (418 J/kg/day), unless vomiting occurred more than twice a day. Concentrated formula was not given. When patients were able to tolerate the full volume of formula without vomiting more than twice a day, 0.02 mg/kg atropine was administered orally six times a day before feeding. Intravenous atropine treatment was considered unsuccessful if patients failed to tolerate half of the full volume within a week or the full volume within two weeks. They were discharged from the hospital when vomiting was controlled with oral atropine. When patients were free of vomiting and showed steady weight gain, atropine was decreased in three steps (0.12 mg/kg/day, 0.06 mg/kg/day, 0.03 mg/kg/day). If patients vomited more than twice a day for three days after discontinuation of atropine treatment, oral administration was restarted.

Follow up

Successfully treated patients were followed up.

Clinical symptoms

Daily frequency of vomiting, recorded in medical charts during intravenous treatment and in guardians’ diaries during oral treatment, was examined at three weeks, three months, and six months after completion of oral atropine administration.

Physical development

Serial changes in body weight were examined at presentation and at the ages of 3 months, 6 months, 1 year, and 2 years. Weights were converted into standard deviation scores (SDS) using data from Japanese infants, published in the national survey for 1990 (Ministry of Health and Welfare, Japan).
Ultrasonographic evaluation of the pylorus

Ultrasonographic evaluations were conducted at presentation, at three weeks and six months after completion of oral atropine administration, and at 1 year of age. Ultrasonography was performed by the same paediatric radiologist (MN) using a Yokogawa Medical RT4600 and 7.5 MHZ linear probe. The patients were fasted for more than three hours before ultrasonographic examination and were not sedated. The examination was performed on several planes. The thickness of the pyloric muscle and the length of the pyloric canal were measured on transverse views, which showed the pylorus along its long axis. Transpyloric flow of gastric contents was also examined. All patients were followed up until 2 years of age.

Statistical analysis

All data are presented as median (range). Tests for statistically significant differences in weight SDSs and ultrasonographic measurements were analysed using the Kruskal-Wallis test. Categorical variables were compared using the Tukey test.

RESULTS

At the time of presentation, 12 patients had previously received infusions at other hospitals, and dehydration and/or electrolyte imbalance were not noted. Of the 19 patients, 17 became free from projectile vomiting during atropine treatment. Figure 2 shows serial changes in pyloric muscle thickness and pyloric canal length. Pyloric muscle thickness was 2 (2–4) mm six months after completion of oral atropine and 2 (2–3) mm at 1 year of age, both of which were significantly less than that at presentation. Pyloric canal length showed significant (p < 0.01) changes during atropine treatment. Figure 2 shows serial changes in pyloric muscle thickness and pyloric canal length. Pyloric muscle thickness was 2 (2–4) mm six months after completion of oral atropine and 2 (2–3) mm at 1 year of age, both of which were significantly less than that at presentation. Pyloric canal length

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Table 1 Characteristics of subjects

Unsuccessful cases

IV, Intravenous atropine administration.

Figure 1 Serial changes in weight standard deviation scores (SDS) in patients successfully treated with atropine. Box, interquartile range; horizontal bar, median; whiskers, 10th and 90th centile. *p < 0.01, **p < 0.05.
problems. The adverse events in the series of Nagita et al. maintained in a safe range and there were no serious clinical complications were not encountered. One patient had a urinary tract infection and one a transient slight increase in serum aspartate aminotransferase and alanine aminotransferase (< 60 IU/l) during intravenous atropine administration. Facial flushing was not reported during treatment. The resting heart rate remained less than 160 beats/min.

DISCUSSION

Medical treatment with atropine has been reappraised as an option for IHPS treatment, using a step up dosage technique with intravenous atropine administration and was associated with a successful short term outcome. The clusters of tonic and phasic pyloric contractions characteristic of IHPS recently reported are transiently abolished by an intravenous atropine injection of 0.01 mg/kg. We thought that this dose of atropine would improve transpyloric flow by inhibiting the contractions. We therefore used this as a fixed dose before feeds six times a day. This was in contrast with the regimen of Nagita et al., in which the dose of atropine was increased until projectile vomiting was controlled. In that study, the dose of atropine actually given was 0.07 (0.04–0.11) mg/kg/day, and 12 of 22 patients received a dose greater than that used in our study.

During the intravenous administration, heart rate was significantly less than that at presentation. The value of intravenous atropine as a treatment for IHPS remains controversial. It has not gained wide acceptance mainly because it requires a prolonged hospital stay and treatment at home. Although pyloromyotomy has been regarded as the optimum treatment of IHPS, the actual and potential consequences of surgery cannot be ignored. It has not gained wide acceptance universally available. A randomised controlled trial comparing the outcomes and cost effectiveness of intravenous atropine versus surgery is required.

REFERENCES

12 Sauverbrei EE, Paloschi GGB. The ultrasonic features of hypertrophic pyloric stenosis, with emphasis on the postoperative appearance. Radiology 1983;147:503–6.