Low-dose Intramuscular Ketamine for Anesthesia Pre-induction in Young Children Undergoing Brief Outpatient Procedures

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The authors sought to determine whether intramuscular ketamine (2 mg/kg) would facilitate inhaled induction of anesthesia in those children who are uncooperative. Thirty-five children were anesthetized with halothane and nitrous oxide for insertion of tympanotomy tubes. Twenty of those children were deemed by the anesthesiologist to be uncooperative and received 2 mg/kg of ketamine im prior to induction of anesthesia. The onset time (time from ketamine administration until induction of inhaled anesthesia could be started) was 2.7 ± 0.3 min. The quality of the subsequent acceptance of inhaled induction with halothane was excellent in 61% of the patients and adequate in the remaining 39%. The recovery and discharge times were compared with those observed in 15 matched children who accepted induction of anesthesia via a mask without the use of ketamine. Recovery time was not prolonged, but home discharge was delayed by an average of 15 min in the ketamine group (p < 0.04).

Low-dose im ketamine was found to be an acceptable pre-induction drug in young children who are uncooperative for an inhaled induction of anesthesia. (Key words: Anesthesia: pediatric. Premedication: ketamine.)

Inhaled induction of anesthesia is not always acceptable to unpremedicated children. A stormy induction may result in unpleasant memories following anesthesia. A drug is needed that is easy to administer, induces sedation rapidly, makes the induction of inhaled anesthesia acceptable to the infant and young child, and does not result in prolonged postanesthetic sedation following short operations. We examined the sedating effect and time to acceptance of breathing via a mask following the use of low-dose im ketamine (2 mg/kg) in young children undergoing brief outpatient procedures. Recovery and discharge times were compared with those observed in a similar group who had undergone inhaled induction of anesthesia with nitrous oxide, oxygen, and halothane.

Methods

The protocol was approved by the institutional review board, and parents were informed about the study. Thirty-five unpremedicated children 1–3 yr of age scheduled for bilateral insertion of tympanotomy tubes under general anesthesia were studied. In 20 children who were judged to be uncooperative by the anesthesiologist, anesthesia was induced by injecting 2 mg/kg of ketamine (100 mg/ml) in the deltoid muscle using a 25-g, ½ inch needle. Onset time was defined as the time from ketamine injection until the child became sedated enough to accept a combination of 70% N₂O and up to 3% halothane delivered via a face mask held close to but not touching his face. The quality of the subsequent inhaled induction was rated as excellent if the child did not object to the inhaled gases, adequate if there was slight resistance or the child turned his head away from the smell but without pushing the mask away, or unacceptable if the child continued to cry or pushed the mask away. In the remaining 15 patients who were cooperative with breathing via a mask, induction was accomplished by inhalation of N₂O and halothane. Anesthesia was maintained with N₂O, O₂, and halothane delivered via face mask in all cases. The recovery time was defined as the interval from discontinuation of the anesthetic gases until the child met the Aldrete Post-Anesthesia Recovery Room (PARR) discharge criteria. The discharge time was the time required for the child to meet the following criteria for release from the hospital: alert and oriented, stable vital signs, ambulation with minimal assistance (when appropriate for age), and ability to tolerate clear liquids with only minimal nausea and vomiting. A phone call was made to the parents 24 h postoperatively to inquire about postdischarge complications and/or complaints. Parents were asked specific questions about vomiting, bad dreams, loss of appetite, dizziness, stomach upset, and excessive sleepiness. The recovery and discharge times in patients who received im ketamine were compared to those recorded in the children in whom both anesthesia induction and maintenance were accomplished by the inhalation of N₂O and halothane. This comparison was analyzed by a two-sample t test.

Results

The mean age and weight of the patients are shown in table 1. Because only children who cooperated with breathing via a mask were assigned to the halothane group, they all had excellent inductions of anesthesia. Although children who did not initially cooperate with breathing via a mask, and therefore received ketamine, cried or whimpered during the injection, they became...
calm and cooperative 2.7 ± 0.3 min later. Their eyes remained open, and nystagmus was frequently present. Excessive salivation was not observed. The quality of the subsequent halothane induction in the children who received ketamine was judged excellent in 61% of cases and adequate in the remaining 39%. There were no unacceptable inductions following ketamine administration. The anesthesia times were shorter and the discharge times longer in the ketamine group (table 1). There were no incidents of any behavioral changes or psychologic disturbances that were observed by parents within 24 h of surgery.

Discussion

Several approaches claim to achieve cooperation of children during inhalation induction of anesthesia. Rectal administration of methohexital has gained wide acceptance since the early report of its successful use by Goresky and Steward. Following a dose of 25 mg/kg (10% solution), most children fall asleep in 6–11 min. Even following short surgical procedures, this dose does not significantly delay immediate or late recovery. Rectal methohexital, however, is most suitable for children 1–3 yr of age. Many older children may be more upset by introducing the drug into their rectums than by an injection. The onset time is considerably longer with rectal methohexital than that of im ketamine, which makes the technique less practical in a child who decides to refuse an induction of anesthesia via a mask at the last minute.

Although the use of im injections is generally undesirable as a routine practice in pediatric anesthesia, it may be indicated in uncooperative patients. When a struggling child refuses the mask and cannot be managed by an iv induction of anesthesia because of lack of accessible veins, a small sedating im injection of ketamine appears to be a safe and humane alternative to induce sleep.

The experience with im injection in children has thus far been limited to the use of full induction doses of methohexital or ketamine. Methohexital is an effective im induction agent in children. A dose of 6 mg/kg injected deep into the muscle has been reported to induce sleep in less than 5 min in patients from 1 to 3 yr of age. When only a single dose was used, recovery was rapid and complete. Methohexital, however, is an alkaline solution and requires deep im injection, which can be painful. Although no local reactions or subsequent soreness at the injection site were reported, the technique is unpopular with young children. Ketamine however, is well recognized as a successful drug to use for induction of anesthesia, and it can be injected im in a small volume. These doses (5–10 mg/kg), however, result in lengthy recovery time, and often patients are unable to take oral fluids for many hours after surgery. However, the use of a smaller induction dose (5 mg/kg), followed by a thiopental, nitrous oxide, oxygen and muscle relaxant technique is associated with only minimal prolongation of recovery time. When children are given a low dose of ketamine, hallucinations and nightmares do not appear to be a problem. Krantz reported no instances of unpleasant dreams or emergence phenomena following administration of 2–2.5 mg/kg of im ketamine used for brief (<5 min) outpatient procedures in children. No such findings were observed in our patients either. Detailed psychologic testing was not employed in either study, however. Recovery time averaged 13 ± 7.6 min, which is satisfactory for outpatient anesthesia. Because excessive salivation was not observed with low-dose im ketamine, the routine administration of atropine is not necessary.

Transmucosal administration of short-acting narcotics is also an effective way of producing preoperative sedation in pediatric patients. Only a few analgesics have thus far been evaluated. Although successful use of oral transmucosal fentanyl (15–20 μg/kg) as well as nasal sufentanil (1.5–3 μg/kg) have been reported, much additional experience is still needed before the ultimate place of these techniques is firmly established.

This study was designed to examine the response to ketamine in children who did not originally accept induction of anesthesia via a mask. Although the lack of randomization does not bias our reporting of recovery and discharge times in the study groups, this fact makes it meaningless to compare the quality of induction with that observed in children who cooperated with inhaled anesthesia in the first place. One obvious bias of design in this study is that we believe that it is better to use an im injection in the child who refuses to cooperate with a mask induction rather than proceed with a forced “smothering” inhaled induction of anesthesia. The validity of this assumption or comparing the acceptance of im ketamine to other available methods of induction is not addressed in this paper.

In summary, our results show that low-dose im ketamine is an acceptable pre-induction agent in young chil-

| Table 1. Age, Weight, Anesthesia, Surgery, and Recovery and Discharge Times for Patients Who Received Ketamine versus Halothane Induction (mean ± SD) |
|-----------------------------------------------|-----------------|-----------------|-------------------|------------------|------------------|
| Age (mo)                                      | Ketamine (n = 20) | Halothane (n = 16) | P*                |
| Weight (kg)                                   | 20.7 ± 4.9      | 24.75 ± 9.66    | NS                |
| Anesthesia time (min)                         | 16.4 ± 4.6      | 20.3 ± 5.0      | <0.001            |
| Surgical time (min)                           | 7.3 ± 5.0       | 8.5 ± 5.4       | NS                |
| Recovery time (min)                           | 14.5 ± 4.9      | 15.9 ± 4.7      | NS                |
| Discharge time (min)                          | 74.7 ± 14.1     | 61.3 ± 21.5     | <0.04             |

* Two-sample t test.
It is especially useful in pediatric patients who do not cooperate with other methods of induction. The onset time is short. Even following very brief surgical procedures, the recovery time is not prolonged when compared to pure inhaled techniques. Even though the total discharge time is statistically longer than when halothane without ketamine is used, the actual delay is minimal. There were no emergence or postanesthetic reactions. Although this technique is not recommended as a routine induction method in all children, it deserves more frequent consideration in the management of "difficult" pediatric patients.

References