CI-581 IN ANAESTHESIA FOR TONSILLECTOMIES IN CHILDREN*

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CI-581 (KETALAR), a phencyclidine derivative, is a new parenterally administered anaesthetic drug.¹ Its action is fundamentally different from the barbiturates, narcotics, or tranquillizers which have been used in conjunction with anaesthesia. CI-581 produces a state of unresponsiveness to external stimuli combined with amnesia. Rather than anaesthetized, the patient appears to be disconnected from his surroundings as in an acute catatonic state. Corssen described this as "dissociative anaesthesia."² Muscle tone remains, but there is an akinesia and loss of orthostatic reflexes. Withdrawal from painful stimuli or defensive reactions as seen in light anaesthesia are virtually absent. There is a moderate elevation of blood pressure. Respiration is usually adequate. Protective pharyngeal reflexes, including cough, swallowing and gagging are retained, and the tongue is maintained in its normal position.

Because of the retention of pharyngeal reflexes under this type of anaesthesia, one might speculate that surgery in the area of the pharynx would be difficult if not impossible.¹ However, trials with dental extractions and irrigation of tear ducts in children were so pleasantly successful that we were encouraged to venture further.

Since tonsillectomy is a rather standardized and frequently performed procedure it lends itself to evaluation of factors introduced by different anaesthetic techniques. We decided, therefore, to use CI-581 for induction and maintenance of anaesthesia for tonsillectomies, to determine its usefulness in this area of surgery.

METHOD OF STUDY

Three anaesthetic procedures were used.

Group A included 20 cases where anaesthesia was induced with 1 mg of CI-581 per pound of body weight intravenously, followed by succinylcholine for endotracheal intubation. Anaesthesia was maintained with 70 per cent nitrous oxide, 30 per cent oxygen, and further injections of CI-581 equal in amount to the induction dose as necessary.

Group B consisted of 54 cases where induction with CI-581, 1 mg per pound, was followed by succinylcholine, endotracheal intubation, and maintenance with nitrous oxide-oxygen and halothane.

Group C was a series of 49 tonsillectomy patients anaesthetized conventionally with pentothal or gas induction and maintained with nitrous oxide and halothane

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or methoxyflurane. These were used as the control group and were done by other anaesthetists during the same time period as groups A and B.

Hyoscine alone was used as premedication in all patients receiving CI-581. In the control group a variety of drug combinations were used; all of these included atropine or hyoscine.

The patients ranged in age from two to fourteen years; the age distribution was comparable in all three groups. The surgery was done by the same E.N.T. specialist in all three groups, using the technique of sharp dissection and tonsil snare. The heart rate was monitored in all groups; the blood pressure in the CI-581 group only. The volume of suction was considered equal to the operative blood loss and was determined by weighing the suction bottle at the end of the operation.³

In the recovery room the patients were assessed every fifteen minutes by experienced recovery room nurses to determine vital signs, responsiveness, restlessness, crying, and vomiting.

OBSERVATIONS DURING ANAESTHESIA

The onset of anaesthesia following intravenous injection of CI-581 was almost immediate, as indicated by a widening stare and slight nystagmus. A muscle relaxant was necessary for intubation. Although laryngoscopy was easily performed without a relaxant, any direct stimulation of the larynx caused it to constrict; it relaxed upon cessation of stimulus and there was no tendency to laryngospasm. The relaxation provided by succinylcholine was adequate and of the expected duration except in one case of subsequently demonstrated abnormal pseudocholinesterase.

In group A with CI-581 maintenance, the endotracheal tube was well tolerated but the patients tended to swallow occasionally. Swallowing seemed unrelated to surgical stimulation and became more frequent towards the end of the CI-581 effects; this was a major indication for a supplementary injection. This spontaneous swallowing was objectionable to some of the surgeons.

The average time interval between doses was ten minutes. Some children required only one and others two supplementary injections, and the average total dose for a tonsillectomy was 2.2 mg per pound of body weight.

In group B, the transfer from CI-581 induction to nitrous oxide and halothane maintenance was smooth and satisfactory. Halothane 1.5 per cent was used for the first few minutes, then reduced to a maintenance level of 0.7 to 1 per cent.

The mean duration of operation was 23 minutes in group A, 26 minutes in group B, and 25 minutes in group C. All the children breathed spontaneously, and respiration was judged adequate on clinical observation.

Induction with CI-581 was followed by a rise in blood pressure above the immediate preoperative level (Fig. 1). In group A, the blood pressure remained elevated throughout the course of the operation. In group B, where halothane was added for maintenance, the average change was less, but in the majority of cases the blood pressure remained above the preoperative level for the duration

FIGURE 1. Blood pressure changes in group A (CI-581) and group B (CI-581 and halothane).

of surgery. The heart rate varied widely and there was no significant difference between the three groups (Fig. 2).

Bleeding during dissection was brisker when CI-581 was used, but haemostasis by application of pressure was as easily obtained as in cases under conventional anaesthesia. No problems with haemostasis were encountered. The blood loss was highest in group A, with a mean of 7.2 ± 3.2 ml/kg. This was significantly different from the mean blood loss of 3.7 ± 1.7 ml/kg in the control group. In group B the blood loss was 5.6 ± 2.9 ml/kg. A graph of the distribution of the three groups according to blood loss (Fig. 3) shows a distinct shift to the right in group A, and there appears to be a relationship between the rise in blood pressure and increased blood loss.

OBSERVATIONS DURING RECOVERY

The recovery time of group A was longer in comparison to the other two groups (Fig. 4). Fifteen minutes after surgery, 80 per cent of the patients in group A were still unresponsive to any stimulus, compared to only 15 per cent in group C. After 45 minutes only 40 per cent of the patients in group A were considered conscious by the nurses and 30 per cent able to sit up, while in group C nearly all

FIGURE 2. Changes in heart rate.

were conscious and 75 per cent were in control of their positional reflexes. Group B shows only a slight retardation in recovery in comparison to the controls.

In defense of CI-581 it must be stated that recovery from CI-581 is different from the recovery from conventional anaesthesia. Although the patients in group A were judged unresponsive for a longer period of time, they possessed active pharyngeal reflexes protecting them from obstruction and aspiration from the moment of extubation. However, the recovery room nurses applied conventional standards of judgment and kept these children under observation until they reached the stage comparable to those who received usual anaesthesia. As a result the average stay in the recovery room was longer in group A (95 ± 25 min) than in groups B (69 ± 20 min) or C (63 ± 16 min).

A comparison of the behaviour of these children in the recovery room showed that those in group A were quiet early in the recovery period (Fig. 5) and became more active towards the 45-minute mark. Conversely the children in group C receiving conventional anaesthesia were active very soon after the termination of anaesthesia but as a group had settled down at 45 minutes. The incidence of crying (Fig. 6) followed the same pattern; children with CI-581 were quieter during early recovery but noisier at 45 minutes than those recovering from conventional anaesthesia.

FIGURE 3. Distribution of blood loss in ml/kg in groups A, B, and C.

The high incidence of vomiting after CI-581 anaesthesia was a surprising observation. In group A 30 per cent of the children vomited in the recovery room; in group B 40 per cent, and in group C only 21 per cent. Observing the children in groups A and B during recovery, one was impressed by the increased salivation and continuous reflex swallowing during the early part of recovery. It is likely that these children swallowed blood, saliva and air both during surgery and in the recovery room, which in turn made them more prone to emesis.

The late postoperative course was satisfactory in all patients. There were no delayed haemorrhages and the children who received CI-581 did not behave differently to the control group in this period. No unusual problems were reported to us from surgeons or parents.

DISCUSSION

An agent reported to provide a retention of reflexes protecting the airway appears unlikely to be useful for tonsillectomies. However, our first curious attempts with CI-581 were surprisingly successful and prompted the present study. Certainly CI-581 can be used for induction and maintenance of anaesthesia for tonsillectomies; the occasional swallowing movement did not particularly interfere with the surgical procedure, but made the surgeon uneasy, since he felt the patient was waking up.

FIGURE 4. Recovery from anaesthesia in groups A, B, and C. Unresponsive: no reaction to name or simple commands. Conscious: responding to commands and simple questions. Able to sit up: sitting up in bed, unaided, on request.

The brisk bleeding encountered during dissection was of more concern; the blood loss under CI-581 anaesthesia was almost double that under conventional anaesthesia. The cardiovascular system responds to CI-581 with a rise in blood pressure due to a rise in cardiac output.⁴ In tonsillectomy, dissection of the tonsil is carried to completion before haemostasis is secured by pressure applied to the tonsil bed. The magnitude of the temporary uncontrolled bleeding will depend on blood pressure and peripheral blood flow, both of which are augmented during CI-581 anaesthesia. All surgical interventions of a similar nature will likewise encounter a greater blood loss. However, natural haemostatic mechanisms are unimpaired, and haemostasis by application of pressure is readily obtained; in fact, it was an impression that bleeding was easier to control under CI-581 than in cases with conventional anaesthesia.

Halothane will counteract the cardiovascular effects of CI-581 ,⁵ and in the cases of halothane maintenance following CI-581 induction (group B) the blood pressure level was lower and there was less blood loss.

Induction with CI-581 is rapid, smooth, and quiet: indeed the transition from the awake to the anaesthetic state is somewhat difficult to notice. In our opinion, CI-581 has advantages as an induction agent in children. There is no excitement stage; respiratory and circulatory depression do not occur, and pharyngeal and

FIGURE 5. Incidence of restlessness during recovery (time after end of operation).

laryngeal reflexes are retained. Laryngoscopy under α -581 is readily accomplished, but insertion of an endotracheal tube requires the use of a topical anaesthetic or a muscular relaxant. The absence of any tendency toward laryngospasm is remarkable; although the larynx contracts briskly on stimulation, it relaxes shortly after its cessation, allowing unobstructed breathing to continue. Once the endotracheal tube is in place, there is no problem with bucking or coughing if gross movements of the tube are avoided.

Recovery was slow when compared with conventional anaesthesia. However, the mode of recovery is quite different. After α -581 the children are quieter and probably easier to nurse. The incidence of crying and restlessness appears to be influenced by the surroundings; at a certain stage of recovery from α -581, children seemed to be induced to cry by other crying children.

Following α -581 there seems to be a greater tendency to swallow and we believe the swallowing of blood, saliva, and air contributed toward the high incidence of vomiting. A similar incidence of postoperative vomiting was observed after dental surgery, but not in children with procedures outside the oral cavity.⁶

FIGURE 6. Incidence of crying during recovery (time after end of operation).

SUMMARY

ci-581 can be used as the main agent for tonsillectomies in children. However, the technique described was not entirely satisfactory; the occasional swallowing disturbed some surgeons and the blood loss was greater, due to elevated blood pressure.

Induction of anaesthesia with ci-581 offered advantages and, when combined with halothane for maintenance, provided good anaesthetic conditions.

Laryngeal reflexes were active under ci-581 but no tendency toward laryngospasm was observed. Intubation was easily accomplished with succinylcholine or under topical anaesthesia, and the endotracheal tube was well tolerated.

The pattern of recovery from ci-581 differed from that seen with conventional anaesthesia, and there was a longer stay in the recovery room. There was a higher incidence of post anaesthetic vomiting with ci-581, and this was possibly related to the frequent swallowing during early recovery.

RÉSUMÉ

On peut employer le *ci-581* en qualité d'agent principal pour les amygdalotomies chez les enfants. Toutefois la technique décrite n'a pas donné entière satisfaction; la déglutition éventuelle a dérangé quelques uns des chirurgiens et les pertes sanguines, à cause de la tension artérielle élevée, ont semblé plus considérables qu'à l'ordinaire.

C'est à l'induction de l'anesthésie que le *ci-581* présente des avantages; si, pour le maintien, on l'associe au fluothane, il procure une bonne anesthésie.

Avec le *ci-581* comme agent, les réflexes laryngés étaient assez vifs, mais nous n'avons pas observé de tendance au laryngospasme. En ce qui concerne l'intubation, elle se pratiquait sans difficulté soit avec la succinylcholine soit sous anesthésie locale et le tube endotracheal était bien toléré.

L'allure du réveil après administration de *ci-581* est un peu différente de ce qu'on observe après une anesthésie conventionnelle et le séjour à la salle de réveil est légèrement plus long. Après l'usage du *ci-581*, la fréquence des vomissements est plus grande; cela peut être attribuable à la déglutition fréquente observée au début du réveil.

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