Ketamine for Obstetric Delivery

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Ketamine has been suggested as a suitable general anesthetic for cesarean sections[1,2] and vaginal deliveries.[3-7] However, little emphasis was put on the effects of ketamine on the fetus. Some Apgar scores were acceptable, others were not, and detailed analysis of these reports seemed to point to the fact that the Apgar scores were related to the total dose of ketamine.

Kubli and Ruttgers[8] showed that oxytocic drugs during labor could significantly depress the fetus. A previous study[9] of the effects of ketamine on the pregnant uterus in the second trimester showed that it has oxytocic effects on the uterus. However, only one dose (2.2 mg/kg) of ketamine was used in this study. This investigation was designed to repeat the measurements of uterine tone with various doses of ketamine.

METHODS

Uterine pressure was measured in patients having abdominal hysterotomies for termination of pregnancy. Only A.S.A. Class I patients were included, and informed consent was obtained from each patient. A standard premedication of Pantopon (Roche), 20 mg/70 kg, and scopolamine, 0.4 mg, im, was administered approximately one and a half hours before operation. Anesthesia was induced with thiopental and succinylcholine, iv. The trachea was then intubated and anesthesia provided by a circle system with a flow of 3 l oxygen and 6 l nitrous oxide. d-Tubocurarine in a dose of 24 mg/70 kg was given, and the patient ventilated with a mechanical ventilator. Anesthesia was maintained with intermittent doses of thiopental, meperidine, and *d*-tubocurarine as needed.

The operation proceeded until the peritoneal cavity was opened and the uterus exposed. A trochar was introduced into the amniotic cavity and a rubber catheter (inside diameter 1.8 mm) was threaded through the trochar into the cavity. The end of the catheter was connected to a Statham pressure transducer (P23V) and the whole system was filled with heparinized sodium chloride.[10] The transducer was connected to a Grass amplifier and recorder calibrated in mm Hg. Recordings of baseline uterine activity were taken for 20 minutes; then, ketamine was injected iv in four separate doses of 0.275, 0.55, 1.1, and 2.2 mg/kg, starting at the lowest dose. After each injection, recordings were taken for at least 15 minutes, or until uterine tone returned to preinjection levels. Then the next injection was administered. The catheter was then withdrawn, and the operation continued. During the recording period the abdomen was covered with a sterile towel and left undisturbed.

RESULTS

Five patients were given different successive doses of ketamine. Figure 1 shows the responses of one patient to these four doses. The lower doses increased the individual uterine contractions only, while the higher doses increased the basal tone as well. Figure 2 shows the average increases in uterine tone in the five patients with each dose; this figure shows that all four doses increased basal tone. Doses smaller than 1.1 mg/kg produced only small increases (less than 10 per cent), while 2.2 mg/kg produced a mean increase of almost 40 per cent. In all five patients maximal effects on uterine tone were reached within 2 to 4 minutes after the injection.

DISCUSSION

Chodoff and Stella[3] were the first to report the use of ketamine for vaginal delivery; they used a total average dose of 0.15 mg/lb over 60 seconds, followed by intravenous infusion of much lower doses. This is a low total dose,

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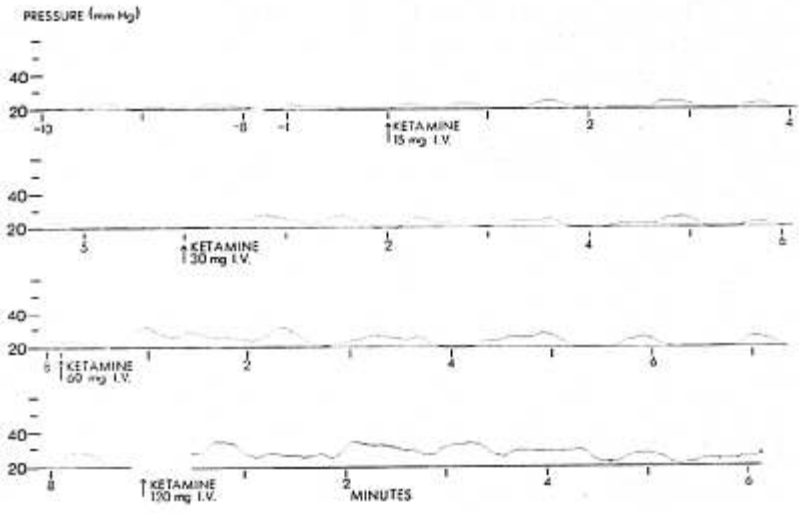

FIG. 1. Responses of uterine tone to cumulative doses of ketamine.

and their 1-minute Apgar scores in 40 infants averaged 9.1. Akamatsu *et al.*[7] used a total dose of 100 mg in 80 patients, and the 1-minute Apgar scores averaged 8.0 (no score was less than 7). Peltz and Sinclair[2] used 1 mg/kg ketamine for cesarean section. The 1-minute Apgar scores averaged 9.0 for their elective cases.

In 49 deliveries, Galbert and Gardner[6] used various doses, ranging from less than 1.4 mg/kg to not more than 2 mg/kg before delivery, with an average 1-minute Apgar score of 7.6. However, eight babies had Apgar scores of 6 or less, and two required resuscitation; there is no indication whether these patients received the higher doses. Little *et al.*[5] used what must be considered high doses. In five deliveries the induction dose was 2.2 mg/kg, followed by iv infusion of 0.11 mg/kg/min. One-minute Apgar scores were 8, 4, 4, 2, and 2, and all infants required intermittent positive-pressure ventilation. Even with a lower induction dose of 1.5 mg/kg followed by 0.08 mg/kg/min, 1-minute Apgar scores averaged only 6, with four of the scores 6 or less; three of the nine infants in this group required oxygen. The authors concluded that this dose of 1.5 mg/kg is rea-

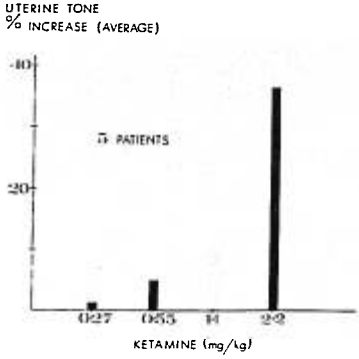

FIG. 2. Mean increases in uterine tone produced by cumulative doses of ketamine.

sonable, but it still seemed too high to the discussants.[5]

The measurements recorded in the study reported here were obtained from women in the second trimester of pregnancy, and the results suggest that there is a dose-related effect of ketamine on the basal uterine tone. Four of the five patients in this study had increases of basal uterine tone of 18, 23, 28, and 71 per cent with 2.2 mg/kg ketamine, and three of the five had increases of 15, 18, and 18 per cent with 1.1 mg/kg. In the previous study,[9] nine of 12 patients had increases of basal uterine tone of 50 per cent or more after one dose of 2.2 mg/kg, iv. If one can extrapolate these results to full-term patients in labor,[11] higher doses of ketamine might endanger the fetus. The clinical reports of its use for delivery support this assumption. When the total dose has been less than 1 mg/kg (approximately), the Apgar scores at 1 minute have been acceptable; when the total dose has been larger than 1 mg/kg some of the Apgar scores have been unacceptable. These reports, and this study, show that ketamine is less than an ideal anesthetic for delivery of a full-term pregnancy, and certainly, when it is used, the study reported here suggests that the total dose before delivery should not be more than 0.55 mg/kg.

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