KETAMINE AND THE PREGNANT UTERUS

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A STUDY of the use of ketamine HCl for dilatation and curettage[1] led to the clinical observation that the uterus was small and firmly contracted at the end of a therapeutic abortion. The blood loss was also noted to be minimal both during and after the operation. In 16 of these patients the customary Syntocin intravenous infusion was not started until the end of the operation, and the uterus was still found to be firmly contracted. This effect compares favourably to the relaxation of the pregnant uterus produced by most other anaesthetics.[2]

This study was designed to provide objective evidence of this purely clinical impression.

METHOD

Uterine pressure was measured in patients having abdominal hysterotomies for termination of pregnancy. Only patients in Grade I of the A.S.A. Classification were included, and informed consent was obtained from each patient. A standard premedication of pantopon 20 mg/70 kg and hyoscine 0.4 mg was given intramuscularly, as nearly as possible one and one-half hours before the operation. Anaesthesia was induced with thiopentone sodium and succinylcholine chloride; the patient was then intubated and attached to a circle system with a flow of 3 litres of oxygen and 6 litres of nitrous oxide. As soon as the effect of the succinylcholine chloride had worn off, tubocurarine chloride in a dose of 24 mg/70 kg was given, and the patient was attached to a ventilator. Anaesthesia was maintained with intermittent doses of thiopentone sodium and pethidine (Demerol, Meperidine HCl), and more tubocurarine chloride was given as required.

The operation was proceeded with as usual until the peritoneal cavity was opened and the uterus exposed, but not disturbed. A trochar was then 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 low sensitivity Statham pressure transducer, and the whole system filled with fluid[3] (heparinized sodium chloride). The transducer was connected to a Grass amplifier and recorder, the system having been previously calibrated in millimeters of mercury. Recordings of uterine activity were taken for 5 to 20 minutes, then ketamine HCl 2.2 mg/kg was injected intravenously and the recording continued for a further 5 to 16 minutes. The catheter was then withdrawn, and the operation continued. During the recording period the abdomen was covered with a sterile towel and left undisturbed.

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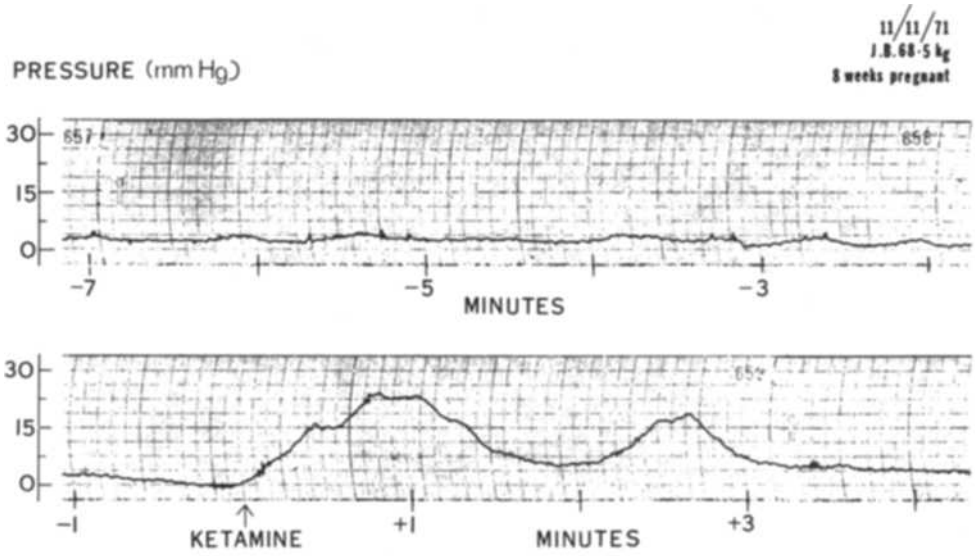

FIGURE 1. Recording of uterine pressure before and after ketamine HCl, in a patient 8 weeks pregnant.

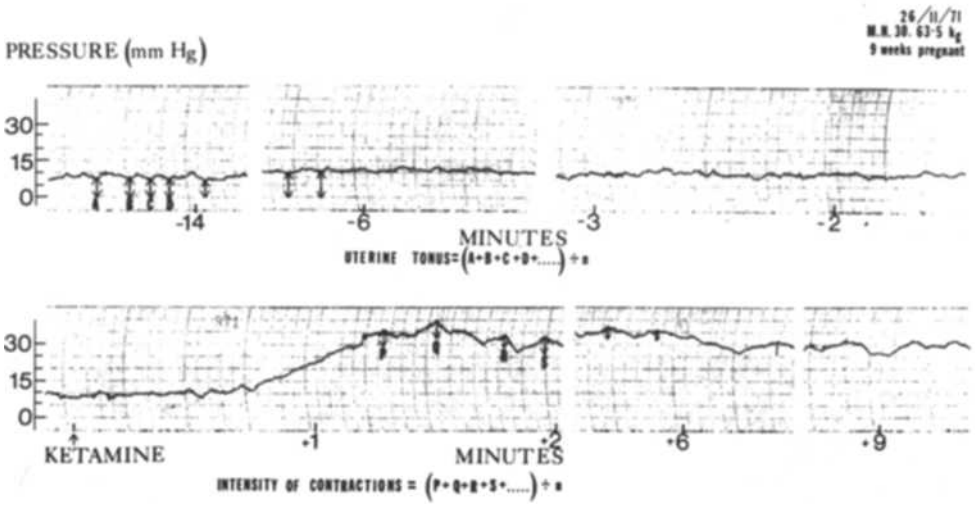

FIGURE 2. Recording of uterine pressure before and after ketamine HCl, in a patient 9 weeks pregnant. Superimposed on the recording are the points measured to calculate uterine tonus and intensity of contractions.

RESULTS

Recordings of uterine pressure were obtained in 12 patients, who were between 30 and 43 years of age and between 8 and 19 weeks pregnant. Each recording was analyzed in terms of the following parameters[4] (see Figure 2):

1. Uterine tonus: the arithmetical mean of all measurements between zero and the lowest pressures between contractions.

2. Intensity (amplitude) of uterine contractions: the arithmetical mean of the rise in pressure of all the contractions over a period of at least 5 minutes.

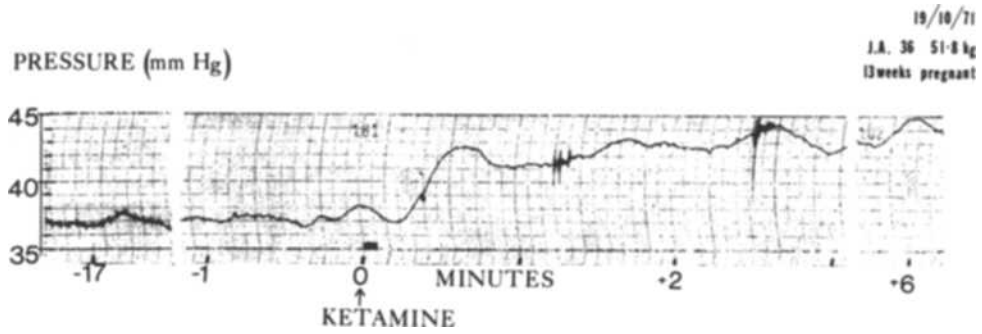

FIGURE 3. Recording of uterine pressure before and after ketamine HCl, in a patient 13 weeks pregnant.

TABLE I

UTERINE TONUS, INTENSITY AND FREQUENCY OF CONTRACTIONS, AND UTERINE ACTIVITY IN ALL 12 PATIENTS BEFORE AND AFTER THE INTRAVENOUS INJECTION OF 2.2 MG/KG OF KETAMINE HCl

	Duration of Pregnancy (weeks)	Mean Tonus (mm Hg)		Mean Intensity of Contractions (mm Hg)		Frequency of Contractions (per 10 minute period)		Uterine Activity (Montevideo Units)	
		Before	After	Before	After	Before	After	Before	After
I.B.	8	14	20	1.0	1.5	16	17	16	25
J.B.	8	1.6	4	1.7	7.8	8	9	13	70
K.E.	9	3	8	1.5	4.5	16	26	24	117
M.N.	9	8	29	2.8	5.0	27	30	75	150
A.S.	9	15	27	2.5	6.0	8	14	20	84
J.C.	9	21	35	1.0	1.4	14	17	14	24
H.T.	11	27	35	1.5	3.0	12	12	18	36
R.D.	12	15	21	1.1	1.5	16	14	17	21
J.A.	13	37	45	1.7	2.0	14	16	23	32
G.L.	14	32	37	1.2	2.3	18	21	22	48
L.T.	16	25	43	5.6	5.7	18	25	100	142
M.D.	19	13	22	1.2	2.1	8	12	9	25

3. Frequency of contractions: the number of contractions in a period of 10 minutes.

4. Uterine activity: the product of intensity and frequency of contractions, expressed as mm Hg per 10 minutes, or Montevideo Units.

Figures 1, 2 and 3 show typical recordings from patients who were 8, 9 and 13 weeks pregnant. The method of calculating the uterine tonus and the intensity of the contractions has been added to the recording on Figure 2. These three patients show the typical response to ketamine HCl. Increases in uterine tonus and intensity of contractions were evident in every one of the 12 patients.

Table I lists the values before and after ketamine HCl in all 12 patients. A paired t-test shows that the mean increase in uterine tonus is significant at the 0.1 per cent level, and the mean increase in intensity of contractions is significant at the 1.0 per cent level. In some patients the frequency of the contractions also increased, but not as much or as consistently as the increases in tonus and intensity. Figure 4 shows the percentage increases of tonus and intensity of contractions after ketamine HCl. Seven patients show an increase of more than 50 per cent in uterine tonus,

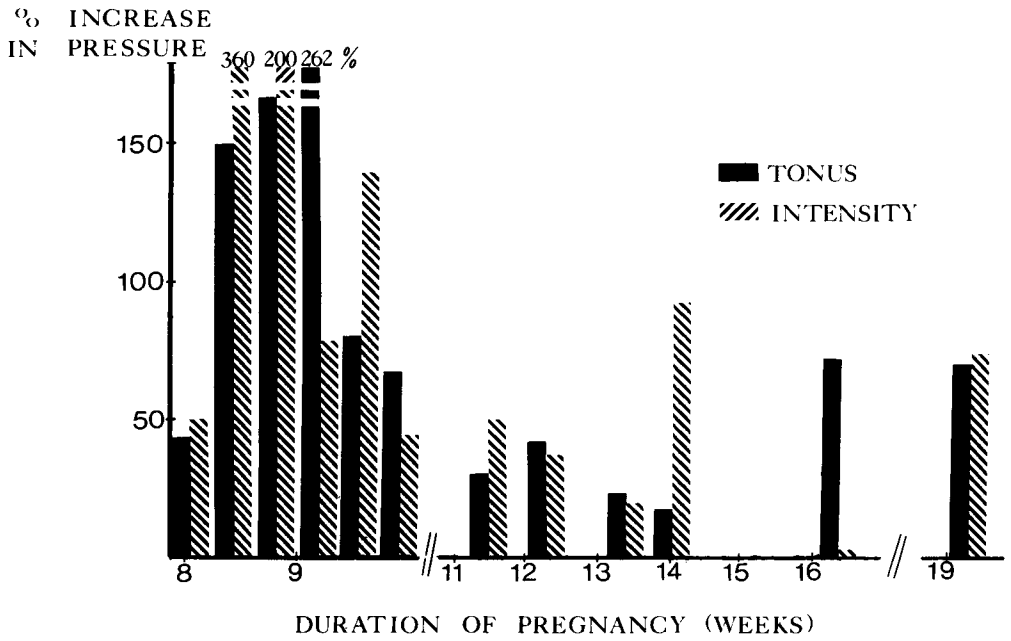

FIGURE 4. Increase in uterine tonus and intensity of contractions after ketamine HCl in all 12 patients. The increase is shown in each patient as a percentage increase over the values before ketamine HCl. Each pair of columns represents one patient.

and three of these show an increase of more than 150 per cent. Similarly eight patients show an increase of 50 per cent or more in the intensity of contractions, and two of these show an increase of more than 150 per cent.

Five minutes after the injection of ketamine HCl the tonus was still increased in 11 of the 12 patients. At 10 minutes the tonus had returned to the pre-injection level in two patients, and was decreasing in another seven; in two patients the recording was stopped before 10 minutes. In four of these seven the tonus reverted to normal by 13 minutes.

DISCUSSION

In 1966 Chodoff & Stella[5] first mentioned firm contraction of the uterus after ketamine HCl, in a report of its use for full-term delivery and the same effect on the uterus in the first trimester of pregnancy was reported in 1971.[1] Both these reports were based on clinical observation only. The study reported here confirms objectively what has until now been pure clinical impression. In every patient the injection of ketamine HCl produced a significant increase in uterine tonus and activity, with the intensity of the contractions increasing more than the frequency.

The small contracted uterus at the end of an evacuation, and particularly the associated minimal loss of blood during and after anaesthesia is a decided advantage of ketamine HCl, when used for the termination of pregnancy in the first trimester. Other anaesthetics used for this operation do not have this effect and some

produce marked relaxation of the uterus.[6] This advantage must be weighed against some of the disadvantages, such as post-operative dreams and disturbances, as with any other anaesthetic.

Summary

Uterine pressure, and intensity and frequency of contractions have been measured in the pregnant uterus before and after the intravenous injection of ketamine HCl. The duration of pregnancy varied from 8 to 19 weeks. In every one of 12 patients, the uterine pressure was higher after ketamine HCl, indicating a more firm and contracted uterus. The intensity and the frequency of the contractions also increased. These effects lasted between 5 to 15 minutes after one injection of ketamine HCl.

Résumé

Dans l'utérus gravide, nous avons mesuré, avant et après l'injection de chlorure de kétamine par voie endoveineuse, la pression utérine, la fréquence et l'intensité des contractions. La durée de la grossesse a varié de 8 à 19 semaines. Chez chacune des 12 malades, la pression utérine était plus élevée après l'injection de chlorure de kétamine, faisant supposer un utérus plus ferme et plus contracté. La fréquence et l'intensité des contractions ont également augmenté. Ces effets, après une injection de chlorure de kétamine, persistent de cinq à quinze minutes.

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REFERENCES

1. Galloon, S. Ketamine for dilatation and curettage. Canad. Anaesth. Soc. J. *18*: 600 (1971).
2. Crawford, J. Selwyn. Principles and practice of obstetric anaesthesia. Oxford, Blackwell, 2nd ed., 171 (1965).
3. Braaksma, J.T., Janssens, J., & Eskes, T.K.A.B. Accurate pressure recording in human uterus. European J. Physiol. *314*: 142 (1970).
4. Caldeyro-Barcia, R. & Poseiro, J.J. Physiology of the uterine contraction. Clin. Obstet. & Gynec. *3*: 386 (1960).
5. Chodoff, P. & Stella, J.G. Use of Cl–581, a phencyclidine derivative for obstetric anaesthesia. Anesth. & Analg. *45*: 527 (1966).
6. MacKay, I.M. Clinical evaluation of fluothane with special reference to a controlled percentage vaporizer. Canad. Anaesth. Soc. J. *4*: 235 (1957).