A COMPARISON OF SOME CARDIORESPIRATORY EFFECTS OF ALTHESIN AND KETAMINE WHEN USED FOR INDUCTION OF ANAESTHESIA IN PATIENTS WITH CARDIAC DISEASE

T. M. Savege, M. P. Colvin, E. J. M. Weaver, C. Bond, J. Drake and R. Inniss

SUMMARY
Cardiorespiratory effects of ketamine and Althesin were measured in two groups of premedicated patients with cardiac disease. The drugs were given in clinically equivalent doses with a second dose administered about 10 min after induction. The first dose of ketamine caused a marked increase in systemic and pulmonary arterial pressure, heart rate, and central venous and wedge pressures and cardiac index. The first dose of Althesin caused a decrease in systemic arterial pressure, central venous pressure, cardiac index and heart work, but little change in heart rate. The second dose of induction agent was administered before the cardiorespiratory effects of the initial dose had resolved. The second dose of Althesin caused changes similar to those following the first dose, but less marked. The changes following the second dose of ketamine were opposite to those following the first dose.

Induction of anaesthesia in patients with heart disease is a hazardous procedure because the impaired circulatory system is less tolerant of depression (Moffit, Tarhan and Lundborg, 1968). Recently, ketamine has been recommended for these patients because it is associated with cardiovascular stability (Szappanyos, Bopp and Fournet, 1969; Corssen et al., 1970). However, marked cardiovascular stimulant effects by ketamine have been reported by others in fit patients (Tweed, Minuck and Mymin, 1972; Savege et al., 1973). Althesin also has been used for the induction of anaesthesia in patients with heart disease. One study was abandoned because of the hypotensive action of Althesin (Harrison and Sellick, 1972). These results were unexpected in view of the findings that the cardiovascular effects of Althesin in fit patients are similar to those of the barbiturate induction agents (Savege et al., 1972).

In this study some cardiorespiratory effects of ketamine and Althesin have been measured in premedicated patients with heart disease. In view of the suggestion that the cardiovascular changes which occur at induction merely reflect the physiological change from the waking to the sleeping state, the results were compared with a second dose which was administered about 10 min later, before the patient was awake and fully aware of his surroundings.

PATIENTS AND METHOD
Patients with heart disease awaiting major cardiac surgery were studied. Most of them had long-standing disease with damage to one or more heart valves. Patients with obvious heart failure, with a history of angina, or with a resting arterial pressure greater than 150/90 mm Hg, in the ward, were excluded from the study.

Measurements
E.c.g. and arterial pressure were measured continuously, displayed on an oscilloscope and recorded on a Devices M19 Recorder. Heart rate was counted manually from either trace.

Blood pressure
The transducers were calibrated against a column of mercury. The zero point was taken as the mid-axillary line.

Arterial pressure was measured using an indwelling femoral artery catheter (Vigon, 25 cm) connected by a minimum length of extension tubing (usually 60 cm) to a Bell & Howell pressure transducer.

Pulmonary artery pressure was measured using a Swan–Ganz thermo-dilution catheter (7 FG) connected to a Cambridge PT8 small volume displacement transducer. The signals were amplified and recorded as two separate traces (phasic and mean) on adjacent channels of the M19 recorder.

Wedge pressure was measured by inflating a balloon on the tip of the catheter with 0.5–2 ml of air.
or carbon dioxide. Wedge pressure was recognized according to the criteria suggested by Mendel (1974). Only mean values of the pulmonary artery pressure and wedge pressure were used in view of the low frequency response of this system.

**Cardiac output**

Cardiac output was measured by thermal dilution using the Devices Cardiac Output computer (Branthwaite and Bradley, 1968). The thermistor (Edwards Swan–Ganz thermal dilution catheter) had been calibrated previously by Devices Ltd, and was positioned in the pulmonary artery. The accuracy of the thermistor was checked, before positioning the catheter, by placing it in a sterile ampoule of distilled water warmed in a water bath to 37 °C. Catheters not within 0.1 °C of the value measured by a mercury thermometer were not used. Ten millilitre of 5% dextrose in water equilibrated at room temperature was used as the indicator and was injected as rapidly as possible.

**Respiratory measurements**

Only limited respiratory measurements were possible because the use of a close-fitting mask tends to distress patients and interfere with resting control measurements (Mendel, 1974). The respiratory frequency and pattern was measured using a chest stethograph, the pressure changes being detected by a Bell & Howell transducer and recorded on a Devices M19 recorder.

**Blood-gas measurements**

Arterial pH, $P_{O_2}$ and $P_{CO_2}$ were measured in all the patients, control samples being taken shortly before induction. Samples were then collected at 3, 6 and 9 min after each dose of the induction agent. In a few cases the 9-min sample was omitted because the patients began to recover consciousness and anaesthesia was continued with other agents. Samples were stored in iced water and analysed as early as possible. Corrections were applied to temperature differences between the machine and the patient (Kelman and Nunn, 1966). A blood-gas factor, measured by using an Adams tonometer, was used to correct $P_{O_2}$ (Adams, Morgan-Hughes and Sykes, 1967).

**Calculations and analysis**

Arterial pressure, central venous pressure and, wherever applicable, wedge pressure were estimated every 12 s from the trace. Consecutive groups of five readings were used to calculate “minute means”. This reduced the variation in these values attributable to breathing, sighing and small movements. If a full minute of recording was not available, for example during the sampling of arterial blood, values were taken from the chart more frequently. A control series of measurements were made before the induction of anaesthesia (over a period of 5 min). Twenty-five values of arterial pressure, central venous pressure, heart rate and, where applicable, wedge pressure were used to calculate the mean control values. Control values before the second dose were those measured over the immediately preceding minute. The last measurement of cardiac output before the second dose was used as the control value; this was usually measured within 2 min of administering the second dose. Measurement of wedge pressure could not be carried out at the same time as the measurement of cardiac output because inflation of the balloon on the Swan–Ganz catheter prevents cold solutions flowing past the thermistor. Consequently, the values used to calculate pulmonary vascular resistance were not obtained simultaneously. The mean change in each variable, at 1-min intervals, was compared with the control value and tested for statistical significance using Student's $t$ test for correlated means.

**Derived values**

The following measurements were derived from established formulae using a program written by one of us (T. M. S.) for a Hewlett Packard 9810A calculator:

1. Surface area (Weir, 1949)
2. Cardiac index
3. Stroke volume
4. Stroke index
5. Mean arterial pressure
6. Systemic vascular resistance (units, mm Hg/litre/min)
7. Pulmonary vascular resistance (units, mm Hg/litre/min)
8. Left ventricular minute work index (joules)
9. Right ventricular minute work index (joules) (Kelman, 1971)

**Dose and rate of administration**

Althesin 0.05 ml/kg was administered over 60 s into a previously cannulated vein. This dose of Althesin was within the optimum dose range suggested by Clarke, Dundee and Carson (1972). Ketamine 2.0 mg/kg was administered over 60 s. This dose is the standard i.v. dose recommended for this drug and
KETAMINE, ALTHESIN AND CARDIAC DISEASE

has been used in cardiac patients (Corssten et al., 1970; Lippman and Cleveland, 1971).

Procedure
The patients were visited on the day before surgery and details of the cannulation procedure were explained to them. All patients were premedicated with papaveretum 20 mg and promethazine 25–50 mg given approximately 1 h before anaesthesia. At the same time, digoxin 0.25 mg and either ampicillin and cloxacillin or erythromycin were administered i.m. On arrival at the operating room the patient was made comfortable on the table and placed in the sitting position if necessary. Oxygen was given via an M.C. face mask, a chest stethograph was placed around the thorax and the e.c.g. was connected. A butterfly needle (19 FG) was placed in a vein on the back of the hand. The right internal jugular vein was cannulated under sterile conditions and a Desilets–Hoffman dilator was inserted (Desilets and Hoffman, 1965). The Swan–Ganz catheter was then passed through the dilator sheath and advanced until a typical pulmonary artery trace was recorded from the distal lumen. The position of the catheter was adjusted until good wedge pressures were obtained on inflation of the balloon.

The femoral artery was cannulated using a percutaneous Seldinger technique. The patients were allowed to rest for about 15 min after the cannulation procedure before a series of control measurements was taken, including repeated measurements of the cardiac output by thermal dilution until two consecutive readings were within 10%. The induction agent was then injected over a period of 1 min into the previously cannulated vein, cardiac output was measured between 1 and 2 min following induction and repeated at approximately 2-min intervals. Wedge pressure was recorded whenever possible following the completion of a measurement of cardiac output.

The second dose was administered about 10 min later, before the patient had awakened. Measurements were then continued until the patient again showed signs of waking, whereupon phenoperidine 2 mg and pancuronium 8 mg were administered and anaesthesia was continued using conventional techniques.

RESULTS
Details of the patients in the two drug groups are in table I.

Systemic arterial pressure (figs 1, 2; table II)
Ketamine caused a marked and sustained increase, in excess of 40%, in arterial pressure. The average systolic pressure increased to more than 200 mm Hg with no evidence of a return to the pre-induction value when the second dose was given. However, after the second dose the mean pressure decreased significantly by a maximum of 11%.

Althesin reduced the mean arterial pressure by 19%, this decrease being maintained until the second dose was given, whereupon there was a further small decrease of 9%.

Pulmonary artery pressure (fig. 2)
Ketamine increased the pulmonary artery pressure by a maximum of 59%, the increase coinciding with a change in systemic pressure. This was sustained until the second dose and then there was a small reduction (11%).

Althesin caused little change in mean pulmonary artery pressure after the initial dose (—7%). A 12% reduction occurred after the second dose, although this was not statistically significant.

Heart rate (fig. 3; table II)
Ketamine increased heart rate by 39%. This was sustained until the second dose when there was a decrease of 15%.

| Table I. Details of patients in the two groups |
|-------------------------------|-------------------|
| **Group** | **Age (yr)** | **Wt (kg)** | **Surface area (m²)** | **Sinus rhythm** | **Atrial fibrillation** |
| Ketamine (6 female, 6 male) | | | | | |
| Mean | 54 | 64 | 1.7 | 10 | 2 |
| SD | 11.8 | 11.4 | 0.2 | | |
| Althesin (7 female, 5 male) | | | | | |
| Mean | 56 | 66 | 1.7 | 5 | 7 |
| SD | 11.3 | 11.2 | 0.2 | 7 | 5 | 0 |
Fig. 1. Mean change in systemic arterial pressure in two groups of 12 patients. One group received ketamine and the other received Althesin. In both groups the induction dose was repeated after about 10 min. △, P < 0.05; ▲, P < 0.01; ▲, P < 0.001.

Fig. 2. Mean change in pulmonary artery pressure compared with mean change in mean systemic pressure in two groups of 12 patients. One group received ketamine and the other received Althesin. △, P < 0.05; ▲, P < 0.01; ▲, P < 0.001.
TABLE II. A comparison of the maximum mean percentage change in cardiovascular variables following the administration of two doses of ketamine and Althesin to two groups of patients

<table>
<thead>
<tr>
<th></th>
<th>Healthy unpremedicated patients* ( n = 6, t = 15 \text{s} )</th>
<th>Premedicated cardiac patients ( n = 12, t = 60 \text{s} )</th>
<th>Healthy unpremedicated patients* ( n = 6, t = 15 \text{s} )</th>
<th>Premedicated cardiac patients ( n = 12, t = 60 \text{s} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Althesin I</td>
<td>Althesin II</td>
<td>Althesin I</td>
<td>Althesin II</td>
</tr>
<tr>
<td>Systolic arterial pressure</td>
<td>(-17)</td>
<td>(-11)</td>
<td>(-21)</td>
<td>(-6)</td>
</tr>
<tr>
<td>Diastolic arterial pressure</td>
<td>(-13)</td>
<td>(-10)</td>
<td>(-18)</td>
<td>(-9)</td>
</tr>
<tr>
<td>Heart rate</td>
<td>(+33)</td>
<td>(+13)</td>
<td>(\pm 3)</td>
<td>(\pm 1)</td>
</tr>
<tr>
<td>CVP (mm Hg)</td>
<td>(-3.1)</td>
<td>(-2.9)</td>
<td>(-1.2)</td>
<td>(-0.6)</td>
</tr>
<tr>
<td>Cardiac output</td>
<td>(+4)</td>
<td>(+6)</td>
<td>(-8)</td>
<td>(\pm 5)</td>
</tr>
<tr>
<td>Stroke volume</td>
<td>(-21)</td>
<td>(+5)</td>
<td>(-9)</td>
<td>(\pm 6)</td>
</tr>
<tr>
<td>Systemic vascular resistance</td>
<td>(-19)</td>
<td>(\pm 0)</td>
<td>(-16)</td>
<td>(+7)</td>
</tr>
</tbody>
</table>

* Savae et al., 1973.

\( t = \) time during which dose was injected.

![Heart Rate Graph](https://academic.oup.com/bja/article-abstract/48/11/1071/377683)

**Fig. 3.** Mean change in heart rate in two groups of 12 patients. One group received ketamine and the other received Althesin. \( \Delta, P < 0.05; \triangle, P < 0.01; \triangle, P < 0.001. \)

Althesin failed to alter heart rate significantly after either the first or the second dose.

No change in cardiac rhythm occurred after induction of anaesthesia with either agent.

Central venous pressure (fig. 4; table II)

Ketamine increased central venous pressure by 55% after the induction dose and then reduced it by 7% after the second dose.
Following Althesin there was a maximum decrease of 11% after the first dose and 6% after the second dose. These changes were not statistically significant.

**Pulmonary wedge pressure (fig. 4)**

Following ketamine pulmonary wedge pressure changes were similar to the changes in central venous pressure. After the first dose of Althesin wedge pressure decreased by 24%. Little change occurred after the second dose.

**Cardiac index/stroke index (fig. 5; table II)**

Cardiac index increased to a maximum of 14%, whereas the stroke index decreased by 17% after the first dose of ketamine. The second dose of ketamine caused a decrease in cardiac index (13%), probably as a result of the decrease in heart rate; stroke index was little changed.

Althesin decreased both cardiac index and stroke index by 9% after the first dose, and there was a further decrease in cardiac index of 5% after the second dose.

**Heart work (fig. 6)**

Left and right ventricular work index was increased markedly after induction with ketamine (70% and 90% respectively). In contrast, there was a decrease in excess of 20% after the second dose reflecting the reduction in arterial pressure and cardiac output at that time.

Heart work was reduced after both doses of Althesin (I: LV = 23%, RV = 17%; II: LV = 12%, RV = 11%).

**Systemic vascular resistance (fig. 7; table II)**

Ketamine increased systemic vascular resistance by 33% after the initial dose, and by 11% after the second dose. The latter increase was not statistically significant.

Althesin reduced systemic vascular resistance after both doses (16% and 12%).

**Pulmonary vascular resistance (fig. 7)**

This was increased after ketamine by a small amount and continued to increase after the second dose.

Althesin increased pulmonary vascular resistance after the induction dose, but there was little further change after the second dose. None of these changes was statistically significant.

**Respiratory changes (fig. 8)**

Following the induction dose, $P_{aCO_2}$ increased by comparable amounts; an increase of 0.9 kPa after

![Graphs](https://academic.oup.com/bja/article-abstract/48/11/1071/377683/1076)
Fig. 5. Mean change in stroke index and cardiac index in two groups of patients. One group received ketamine and the other received Althesin. $\Delta, P < 0.05$; $\triangle, P < 0.01$; $\blacktriangle, P < 0.001$.

Fig. 6. Mean change in left and right ventricular minute work index in two groups of patients. One group received ketamine and the other received Althesin. $\Delta, P < 0.05$; $\triangle, P < 0.01$; $\blacktriangle, P < 0.001$. 
ketamine and 1.2 kPa after Althesin. However, PaCO₂ continued to increase following the second dose of Althesin by a further 0.6 kPa, whereas there was little change after the second dose of ketamine (table III).

Mean PaO₂ did not change significantly after either drug. In two patients in each group PaO₂ values were less than 10 kPa after induction. In one of them the control PaO₂ was 8.5 kPa.

**TABLE III.** Change in arterial PaO₂, PaCO₂ and pH in patients receiving either ketamine or Althesin (mean ± SD)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Control</th>
<th>Dose I 3 min</th>
<th>Dose I 6 min</th>
<th>Dose I 9 min</th>
<th>Control (before induction)</th>
<th>Dose II 3 min</th>
<th>Dose II 6 min</th>
<th>Dose II 9 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>PaCO₂ (kPa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>5.9</td>
<td>6.4*</td>
<td>6.7*</td>
<td>6.8*</td>
<td>5.9</td>
<td>6.6*</td>
<td>6.8*</td>
<td>6.8*</td>
</tr>
<tr>
<td></td>
<td>(±0.5)</td>
<td>(±0.5)</td>
<td>(±0.5)</td>
<td>(±0.4)</td>
<td>(±0.5)</td>
<td>(±0.4)</td>
<td>(±0.5)</td>
<td>(±0.5)</td>
</tr>
<tr>
<td>Althesin</td>
<td>5.9</td>
<td>6.8*</td>
<td>7.0*</td>
<td>7.1*</td>
<td>5.9</td>
<td>7.5*</td>
<td>7.7*</td>
<td>7.3*</td>
</tr>
<tr>
<td></td>
<td>(±0.8)</td>
<td>(±0.2)</td>
<td>(±1.3)</td>
<td>(±1.3)</td>
<td>(±0.7)</td>
<td>(±1.3)</td>
<td>(±1.7)</td>
<td>(±1.2)</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>7.35</td>
<td>7.33</td>
<td>7.32*</td>
<td>7.33*</td>
<td>7.36</td>
<td>7.36</td>
<td>7.31*</td>
<td>7.31</td>
</tr>
<tr>
<td></td>
<td>(±0.03)</td>
<td>(±0.03)</td>
<td>(±0.04)</td>
<td>(±0.04)</td>
<td>(±0.04)</td>
<td>(±0.04)</td>
<td>(±0.04)</td>
<td>(±0.05)</td>
</tr>
<tr>
<td>Althesin</td>
<td>7.34</td>
<td>7.29*</td>
<td>7.29*</td>
<td>7.29*</td>
<td>7.35</td>
<td>7.28*</td>
<td>7.26*</td>
<td>7.28*</td>
</tr>
<tr>
<td></td>
<td>(±0.02)</td>
<td>(±0.03)</td>
<td>(±0.03)</td>
<td>(±0.03)</td>
<td>(±0.02)</td>
<td>(±0.03)</td>
<td>(±0.04)</td>
<td>(±0.06)</td>
</tr>
<tr>
<td>PaO₂ (kPa)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>19.9</td>
<td>21.0</td>
<td>20.8</td>
<td>20.2</td>
<td>21.3</td>
<td>21.6</td>
<td>22.3</td>
<td>20.8</td>
</tr>
<tr>
<td></td>
<td>(±9.2)</td>
<td>(±10)</td>
<td>(±8)</td>
<td>(±8.7)</td>
<td>(±9.1)</td>
<td>(±10.2)</td>
<td>(±12.1)</td>
<td>(±11.9)</td>
</tr>
<tr>
<td>Althesin</td>
<td>21.6</td>
<td>20.7</td>
<td>22.7</td>
<td>22.8</td>
<td>21.5</td>
<td>22.7</td>
<td>23.0</td>
<td>24.4</td>
</tr>
<tr>
<td></td>
<td>(±6.9)</td>
<td>(±10.5)</td>
<td>(±10.3)</td>
<td>(±10.9)</td>
<td>(±7.2)</td>
<td>(±10.3)</td>
<td>(±10.0)</td>
<td>(±10.4)</td>
</tr>
</tbody>
</table>

(* P < 0.05)

**FIG. 7.** Mean change in systemic vascular resistance compared with change in pulmonary vascular resistance in two groups of patients. One group received ketamine and the other received Althesin. In both groups the induction dose was repeated after about 10 min. △, P < 0.05; ▲, P < 0.01; ▲▲, P < 0.001.
KETAMINE, ALTHESIN AND CARDIAC DISEASE

Respiratory Rate
(b.p.m)

Min/utes

First Dose

Ketamine
2 mg/kg

Second Dose

Althesin
50 µg/kg

FIG. 8. Mean change in respiratory rate in two groups of 12 patients. One group received ketamine and the other received Althesin. In both groups the induction dose was repeated after about 10 min. 

\( \Delta, P < 0.05; \Delta, P < 0.01; \Delta, P < 0.001. \)

DISCUSSION

With three major exceptions, the effects of Althesin and ketamine in this study were very similar to those in a previous study of fit, unpremedicated patients (table II) (Savege et al., 1973).

First, Althesin did not cause tachycardia. This finding is important because Sonntag and his colleagues (1973) observed that Althesin increased myocardial oxygen consumption by more than 50%, as a consequence of increasing heart rate in healthy, unpremedicated volunteers. They concluded that the drug was contraindicated in patients with impaired coronary blood flow reserve. Other studies in healthy, unpremedicated adults have demonstrated similar increases in heart rate (Savege et al., 1971; Coleman et al., 1972). In contrast, previous work in premedicated patients with cardiac disease confirms the finding that there is no change in heart rate that can be attributed to Althesin (Lyons and Clarke, 1972; Broadley and Taylor, 1974).

It is not clear why the response to Althesin is different in the two groups. There are three possibilities:

1. Premedication with atropine-like drugs may increase heart rate and prevent a further increase (Campbell, Miller, and Bradford, 1972). That is unlikely in this study because the control mean heart rate was not increased abnormally (74/min).
2. Premedication with digoxin may increase vagal tone or affect the sino-atrial node (Goodman and Gilman, 1970) and prevent tachycardia.
3. Patients with arrhythmia, for example atrial fibrillation, may behave differently to those in sinus rhythm. Thus a greater increase in heart rate would be expected in those patients in sinus rhythm. Of the Althesin group seven exhibited atrial fibrillation and in five, sinus rhythm was present. Analysis of the change in heart rate in each category (table IV) shows that the greater increase occurred in those with atrial fibrillation.

The fact that ketamine increased heart rate by a similar quantity in both healthy patients and those with cardiac disease implies that its action is different from that of Althesin. Unfortunately, the two groups in this study are not strictly comparable; 10 patients who received ketamine exhibited sinus rhythm compared with only five of those who received Althesin. However, these five patients failed to develop a significant increase in heart rate (table IV).

| TABLE IV. Mean maximum increase in heart rate (beat/min) after initial dose of Althesin in five patients with sinus rhythm compared with seven patients with atrial fibrillation |
|-----------------|-----|-----|-----|
|                  | Control | Maximum | Difference |
| Five patients    | 84 (+27) | 86 (+25) | +2 (+4.8) |
| with sinus rhythm | (t = 0.66, P < 0.05) |
| Seven patients   | 66 (+12) | 75 (+13) | +9 (+4.9) |
| with atrial fibrillation | (t = 4.42, P < 0.01) |
The second major exception was that ketamine increased cardiac index by only 14%, despite a large increase in heart rate and central venous pressure. This probably reflects the limited myocardial reserve of these patients, and the large increase in heart work, for so little improvement in cardiac output cannot be in their best interest. Corssen and his colleagues (1970) recommended ketamine as the sole agent for cardiac surgery because of the remarkable cardiovascular stability that it afforded. It seems likely, however, that this stability was obtained by the simultaneous use of tubocurarine.

The third exception was that 
\[ P_{\text{ACO}_2} \]
 increased considerably (table III), probably as a result of the combined effect of premedication and the induction agent. This increase could have contributed to some of the cardiovascular changes.

The control values for the second dose of both drugs were not the same as the preinduction values and the action of the second dose must therefore have been modified by the remaining effect of the first dose. In general, the second dose of Althesin caused the same effects as the first dose. Ketamine tended to depress the cardiovascular system and the changes were similar to those described in healthy patients (Savege et al., 1973).

Animal studies indicate that ketamine may both stimulate and depress the cardiovascular system (Dowdy and Kaya, 1968; Traber, Wilson and Priano, 1968). The stimulant effect is probably the result of several mechanisms, including depression of baroreceptor discharge (Dowdy and Kaya, 1968), central stimulation and direct vagal blockage (Chodoff, 1972). The central stimulant action does not seem to be mediated through the sympathetic nervous system (McGrath, MacKenzie and Millar, 1975). Alternatively, central excitation could stimulate the cardiovascular system indirectly as a result of increased muscle tone: a constant feature after induction with ketamine but seldom, if ever, seen after the second dose (Savege et al., 1973). One might expect a direct myocardial depressant action of ketamine if its stimulant actions were blocked. This seems to be the case at the time of the second dose where a continuing tachycardia suggests persistent vagal blockade and absence of muscle movement suggests lack of central stimulation; both effects are probably a result of the residual action of the first dose. The same mechanism could account for the failure of ketamine to stimulate the cardiorespiratory system in anaesthetized rabbits paralysed with gallamine (McGrath, MacKenzie and Millar, 1975), especially as the latter abolishes muscle contraction and reduces vagal tone (Eisele, Marta and Davis, 1971).

Both these agents have marked effects on the cardiovascular system. Clearly, neither agent is ideal alone. However, modern techniques require the use of combinations of drugs and these can be selected to counteract the disadvantageous effects, each of the other, and thus achieve cardiovascular stability.

REFERENCES


\[ P_{\text{O}_2}, P_{\text{CO}_2}, \] pH and base excess for time and temperature. J. Appl. Physiol., 21, 1484.


KETAMINE, ALTHESIN AND CARDIAC DISEASE


COMPRAISON DE CERTAINS EFFETS CARDIORESPIRATOIRES DE L'ALTHESINE ET DE LA KETAMINE LORSQU'ON LES UTILISE POUR L'INDUCTION DE L'ANESTHESIE CHEZ DES PATIENTS SOUFFRANT DE MALADIES CARDIAQUES

RESUME

On a mesure sur deux groupes de patients souffrant de maladies cardiaques, prealablement soumis a une medecation, certains effets cardiorespiratoires de la ketamine et de l'althesine. Ces medecaments ont ete administres en doses cliniques equivalents, une seconde dose etant administree 10 min environ apres l'induction. La premiere dose de ketamine a provoque une augmentation marquee de la tension arterielle systemique et pulmonaire, de la frequence cardiaque et des pressions veineuses centrale et triangulaire ainsi que de l'index cardiaque. La premiere dose d'althesine a provoque une baisse de la tension arterielle systemique, de la pression centrale veiuse, de l'index cardiaque et dans le travail du cœur, mais il n'y a eu que peu de changement dans la frequence cardiaque. La seconde dose d'agent d'induction a ete administree avant la fin des effets cardiorespiratoires de la dose initiale. La seconde dose d'althesine a provoque des changements similaires a ceux qui ont suivi la premiere dose, mais ils ont ete moins prononces. Les changements qui ont suivi la seconde dose de ketamine ont ete le contraire des changesments qui ont suivi la premiere dose.

EIN VERGLEICH EINIGER KARDIO-RESPIRATORISCHER WIRKUNGEN VON ALTHESIN UND KETAMIN BEI DEREN VERWENDUNG FUR NARKOSEEINLEITUNG BEI HERZKRANKEN PATIENTEN

ZUSAMMENFASSUNG


COMPARACION DE ALGUNOS EFECTOS CARDIORESPIRATORIOS DEL ALTHESIN Y KETAMINA CUANDO SE USAN PARA INDUCCION DE ANESTESIA EN PACIENTES CON ENFERMEDAD CARDIACA

SUMARIO

Algunos efectos cardiorespiratorios de la ketamina y Althesin fueron medidos en dos grupos de pacientes cardiopatas premedicados. Se administraron los fármacos en dosis clínicamente equivalentes, con una segunda dosis dada unos 10 min tras inducción. La primera dosis de ketamina causó un señalado aumento en la presión arterial pulmonar y generalizada, frecuencia cardíaca, y presiones venosa central y en cuña, y en el índice cardíaco. La primera dosis de Althesin causó un descenso en la presión arterial generalizada, presión venosa central, índice cardíaco y función sistólica, pero poco cambio en la frecuencia cardíaca. La segunda dosis del agente de inducción fue administrada antes de haberse resuelto los efectos cardiorespiratorios de la dosis inicial. La segunda dosis de Althesin provocó cambios similares a los que siguieron a la dosis primera, aunque menos señalados. Los cambios consecutivos a la segunda dosis de ketamina fueron los opuestos a los que siguieron a la primera dosis.