Anaesthetic technique of ketamine infusion: clinical and biochemical evaluation.

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Introduction

The search for a safe and potent non-inhalational general anaesthetic continues specially in view of the recent reports of the possible harmful effects on the personnel working there of the trace amounts of anaesthetics present in the operation theatres and recovery areas. New intravenous anaesthetics, potent analgesics and narcotic antagonists have made the achievement of such an aim easier. Availability of ketamine has given a new concept of dissociative anaesthesia.[4] It has longer and more potent analgesic action than other agents used for induction of anaesthesia. Inspite of this advantage it has not become popular due to many side effects, chief among them being emergence delirium, unpleasant dreams and vomiting in the recovery period and lack of muscular relaxation. The use of lorazepam as pre-anaesthetic medication has considerably reduced the post-anaesthetic side effects.[6], [7], [8], [12], [15] The effect of ketamine as a visceral analgesic remains uncertain.[8], [9], [11], [13], [17], [23]
The beneficial properties of ketamine, particularly its favourable haemodynamic effect and the fact that it does not produce hazardous vapours for the working personnel can be exploited by combining it with suitable pre-medication, proper muscle relaxants and controlled ventilation with oxygen enriched air or nitrous oxide. The aim of the present study was to introduce a new anaesthetic technique in Armed Forces Medical Services (India) for field and peace service conditions and to find out whether it is possible to discard the use of anaesthetic gases and volatile inhalational agents completely. If this is possible for routine and major surgery then it will considerably reduce the risk in transport and handling of inflammable material.

:: Material and methods

One hundred and twenty patients of either sex (Males 52, Females 68), between 20 and 60 years of age, belonging to risk grade I-III (ASA) were selected at random from routine/emergency surgery. Pre-operative assessment was done. All patients were pre-mediated with either lorazepam or pethidine or morphine intramuscularly, 60 to 90 minutes prior to surgery [Table 1], [Table 2], [Table 3]. A bottle having ketamine infusion (500 mg ketamine in 500 ml of isotonic saline) was connected to another bottle having saline solution and to the patient either with a 3-way stop cock or a Y connection. Anaesthesia was induced either with rapid infusion or a single bolus of ketamine (2 mg/kg). Intubation was accomplished by suxamethonium (1 mg/kg) and anaesthesia was maintained with ketamine infusion at variable rates depending upon the reaction of the patients to achieve satisfactory level of anaesthesia. Nondepolarizing muscle-relaxants (curare or pancuronium) were administered to provide muscular relaxation. Patients were divided into three groups:

GROUP I: 20 patients undergoing body surface operation and breathing spontaneously, served as controls.

GROUP II: 50 patients undergoing abdominal or major gynaecological surgery on controlled ventilation with oxygen enriched air incorporating Radcliff respirator or Oxford inflating bellow.

GROUP III: 50- patients undergoing same surgical procedures as in group 11 with manually controlled ventilation using N20 : 02 (70:30 ratio) connected to Boyle's apparatus.

At the end of the surgery, ketamine infusion was discontinued and residual neuro-muscular block reversed with appropriate dosages of atropine : neostigmine mixture.

Vital signs such as blood pressure and pulse were monitored every 10 minutes during the operation. Doses of ketamine administered during induction/anaesthesia and duration of surgery were recorded.

Twenty patients, group of 10 each, were studied for cardiostimulatory responses under controlled ventilation with airoxygen or gas-oxygen using either tubocurarine or pancuronium.

Blood samples for serum electrolytes, blood sugar and blood gas studies were collected at pre-induction, 15 minutes and 30 minutes after induction and two hours post-operatively.

All patients were kept in the recovery ward under expert nursing care.
Immediate recovery assessment and recovery room discharge was based on the following criteria.

A. Orientation: Time, place and person.
B. Consciousness: Graded as under.
   (i) Responds to stimuli but not to verbal command.
   (ii) Rousable but sleeps if undisturbed.
   (iii) Fully awake.
C. Recovery Discharge: A rousable sleep with constant vital signs for 30 minutes.

All patients were interviewed 24 hours after the surgery for intra-operative recall, post-operative amnesia, analgesia, emesis, dreams, hallucinations and other psychotomimetic effects. All the values were statistically analysed to find out the standard deviation (SD) and Student's 't' test was applied to find out the significance of difference.

:: Results

A total of 120 patients were studied which included twenty patients on spontaneous respiration, and 100 patients with controlled ventilation in different groups as indicated under method. Details of patients, premedicant drugs used and surgery performed are given in [Tables 1] and [Tables 2].

In a pilot study of twenty patients breathing spontaneously, average dose requirements of ketamine were higher than controlled ventilation with muscle-relaxants. Duration of surgery and nitrous oxide further affected the dosage of ketamine [Table 3].

The quality of anaesthesia was indistinguishable in patients receiving non-depolarizing muscles relaxants with controlled ventilation either with air-oxygen or nitrogen oxide. At the end of surgery, patients opened their eyes within 30 minutes on loud verbal command or deep stimulus but orientation and full recovery was significantly delayed though active reflexes and control of the airway were intact. Majority of the patients could be discharged from the recovery room of the operation theatre to post-operative ward within 30 to 45 minutes (see [Table 4] and [Table 5]).

Effect on serum potassium

There was a marginal decrease in serum potassium at 15 minutes post-induction period but significant increase (p < 0.01) in air oxygen and decrease (p < 0.01) in gas-oxygen groups when compared with the control group, at 30 minutes [Table 6].

Decrease in serum potassium at 30 minutes was significant in spontaneously breathing and gas-oxygen controlled ventilation patients when compared to their basal values respectively. At 2 hours post-operatively, serum potassium returned to normal or was marginally less than the basal value.

Significant increase (p < 0.05) in blood sugar was observed at 30 minutes after ketamine infusion in air-oxygen and gas-oxygen groups compared to the patients on spontaneous respiration [Table 7]. Blood sugar decreased to almost pre-induction values post-operatively.

Effect on blood gases

There was a significant increase (p < 0.01) in p0, and almost no change in pCO2 in air-oxygen as well as gas-oxygen groups. The decrease in pH was more marked (p < 0.01) in ketamine air relaxant than ketamine gas-relaxant...
series and this metabolic change was persistent in the post-operative period (p < 0.01) even though clinically it was insignificant. Details are given in [Table 8]. There was a higher incidence of emesis, headache and dizziness post-operatively in patients ventilated with air-oxygen as compared to gas-oxygen. There was no significant difference in other post-anaesthetic complications in the two groups of controlled ventilation patients. However, spontaneously breathing patients had comparatively higher incidence of headache and dreams [Table 9].

Cardio-stimulatory action
Patients showed marked individual variation. Peak rise in pulse rate and blood pressure was observed during the first 5 to 10 minutes of anaesthesia which remained higher or gradually decreased to pre-induction level within twenty to thirty minutes. There was no significant difference when ventilation was controlled with air-oxygen or gas-oxygen. The changes observed with pancuronium were not significantly different as compared to tubocurarine [Table 10] and [Table 11].

Discussion

Introduction of non-cumulative, rapidly metabolising, induction anaesthetic agents like Althesin (Glaxo) and Etomidate (Janssen) facilitated the development of total intravenous anaesthesia.[3, 6] Neither of these drugs possesses significant analgesic effects. Ketamine was suggested to be more promising in this respect. It has also provided stable anaesthetic state for major intra-abdominal and thoracic surgery.[11, 16, 17, 18, 19, 20, 23] In India, particularly Armed Forces Medical Services, the problem of gaseous pollution for the personnel working in that area, undesirable and non-availability of inhalational anaesthetics in logics, prompted our team to carry out detailed study on ketamine infusion technique. In this study ketamine infusion was carefully controlled according to the individual patient's response. The tendency to over dosage in spontaneously breathing patients has been stressed[14, 15] but the dosage could be influenced by the mode of ventilation.[11, 12, 19] Since the availability of ketamine in India (1972), the authors have studied over 5000 patients of different age groups and evaluated the anaesthetic risks with this anaesthetic even in adverse circumstances including high altitude without complications on account of cardio-stimulatory action of the drug. The changes observed in the pulse rate and blood pressure were similar to those reported earlier[21, 22] with intermittent bolus dose technique. Blood pressure and heart rate increased significantly from the basal level in the first 5-10 minutes of anaesthesia. There was no difference whether pancuronium or tubocurarine was used contrary to the observations reported by Lilburn.[12]

Recovery of post-anaesthetic orientation and consciousness was delayed as reported by other workers.[1, 2, 10, 20] Majority of the patients were fully awake within 4-5 hours after surgery. Similar observations have been made by Lilburn.[12] Recovery was related to the duration of surgery and persistent effect of pre-medicant drugs. Post-operative period was pleasant and smooth, recovery discharge was within well accepted time limits but expert nursing care for another six hours in the postoperative ward was
considered essential. Postanaesthetic psychotomimetic effects were negligible and all patients had excellent amnesia. Blood gas analysis, serum potassium and blood sugar changes appear to be influenced by premedication, type and duration of surgery, mode of ventilation, sympathetic activity and metabolic changes. There was marginally increased serum potassium, raised blood sugar and decreased pH at 30 minutes after ketamine infusion in patients ventilated with air oxygen. This may be related to stress-induced sympathetic response or metabolic effects of surgery. Sympathetic stimulation appears to be unlikely since the increase in blood pressure and heart rate was observed only in the first 15-20 minutes of ketamine infusion but the biochemical changes were observed at 30 minutes. Our observations are in agreement with those of other workers.[9, 16]

In conclusion, this technique of anaesthesia can be used on a large scale with controlled ventilation either with air-oxygen or nitrous oxide-oxygen mixture.

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:: References


