TOTAL INTRAVENOUS ANAESTHESIA IN DISASTER SITUATION : A METHOD FOR MINOR SURGICAL PROCEDURES WITH SPONTANEOUS VENTILATION

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R é s u m é

ANESTHÉSIE GÉNÉRALE PAR VOIE INTRAVEINEUSE DANS UNE SITUATION DE CATASTROPHE : UNE MÉTHODE POUR DES INTERVENTIONS DE PETITE CHIRURGIE AVEC VENTILATION SPONTANÉE

En raison des risques de pollution de l'atmosphère de la salle d'opération, de l'absence de systèmes complexes d'aération, du coût élevé et de l'indisponibilité de produits anesthésiques absorbés par inhalation, cette étude a pour but d'évaluer les avantages de certains produits permettant de réaliser une anesthésie générale par voie intraveineuse.

Vingt-quatre patients ont été répartis en trois groupes selon la combinaison des trois produits inducteurs de l'anesthésie. Il y a d'abord le groupe du diazepam qui obtient l'induction avec 1 mg/kg de kétamine et 10 mg de diazepam, injectés par voie intraveineuse. Ensuite, il y a le groupe du thiopentone qui obtient l'induction avec 1 mg/kg de kétamine et 4 mg/kg de thiopentone par injection intraveineuse simultanée. Enfin le troisième groupe obtient l'induction au moyen de 1 mg/kg de kétamine et de 2,5 mg de dropéridol administrés par voie intraveineuse : c'est le groupe du dropéridol.

Pour tous ces groupes, l'entretien de l'anesthésie fut réalisé au moyen d'une solution de 0,1 % de kétamine en goutte à goutte en utilisant un set d'infusion IVAC avec contrôle électrique et en administrant de l'oxygène pur (100 %) par voie bucco-pharyngée par emploi d'un masque facial.

Les résultats de cette étude ont montré que l'administration intraveineuse de 2,5 mg de dropéridol avec 1 mg/kg de kétamine, suivie d'administration en goutte à goutte d'une solution de kétamine à 0,1 est la meilleure méthode pour obtenir une anesthésie générale par voie intraveineuse dans les cas d'interventions de petite chirurgie avec ventilation spontanée. Les avantages que présente ce groupe sur les autres groupes sont : une réduction dans la dose totale de kétamine (seulement 200 ± 98 mg), de bonnes conditions dans le cours de l'opération, la brièveté du temps de récupération (7,3 ± 3,6 min) et l'absence de phénomène d'émergence de la kétamine. On a aussi constaté un degré élevé de stabilité en ce qui concerne le rythme cardiaque, la pression artérielle moyenne et le volume-minute. Les autres avantages du dropéridol sont : l'effet antiémétique et la protection contre les dysrythmies cardiaques dues à l'épinéphrine et l'absence de tout risque de phlébite. C'est pourquoi l'auteur recommande l'emploi par voie intraveineuse de 2,5 mg de dropéridol avec 1 mg/kg de kétamine pour la phase d'induction d'une anesthésie générale par voie intraveineuse.

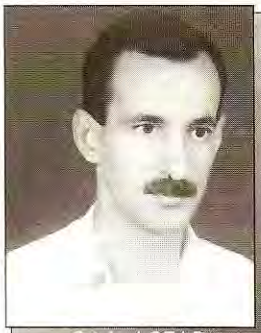
R e s u m e n

ANESTESIA GENERAL POR VÍA INTRAVENOSA EN UNA SITUACIÓN CATASTRÓFICA: MÉTODO PARA INTERVENCIONES DE CIRUGÍA MENOR CON VENTILACIÓN ESPONTÁNEA

Este estudio ha sido planeado para obtener los máximos beneficios de la anestesia intravenosa debido al riesgo de contaminación atmosférica en el quirófano, la falta de sistemas de aireación sofisticados y del elevado coste e indisponibilidad de los agentes anestésicos por inhalación.

Veinticuatro pacientes fueron divididos en tres grupos según la combinación de fármacos en la inducción. El grupo de diacepán se indujo con 1 mg/kg de ketamina y 10 mg de diacepán i.v. El grupo de tiopental se indujo con 1 mg/kg de ketamina y 4 mg/kg de tiopental sódico i.v. Simultáneamente, la inducción del grupo de droperidol se llevó a cabo con 1 mg/kg de ketamina y 2.5 mg de droperidol i.v. En todos los grupos, el mantenimiento se alcanzó con una solución de ketamina al 0.1% en gotero IVAC con control eléctrico y mascarilla de oxígeno al 100%.

El resultado de este estudio muestra que la administración de 2.5 mg de droperidol con 1 mg/kg de ketamina i.v., seguido de una solución de ketamina al 0.1% en gotero, es el mejor método en la anestesia general por vía intravenosa en cirugía menor con ventilación espontánea. Las ventajas de este grupo son la reducción de la dosis total de ketamina (sólo 200 ± 98 mg), las buenas condiciones intraoperatorias, un corto período de recuperación (7.3 ± 3.6 min) y la ausencia de fenómeno de emergencia de la ketamina. También se obtiene una buena estabilidad en la frecuencia cardíaca, presión arterial y volumen minuto. Otros beneficios del droperidol son el efecto antiemético, protección antiarrítmica por epinefrina y nulo riesgo de flebitis. Por todo ello se recomienda el empleo i.v. de 2.5 mg de droperidol junto a 1 mg/kg de ketamina para la inducción de anestesia general intravenosa.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INTRODUCTION

Atmospheric pollution in the operating rooms by anaesthetic gases and vapors, is a major problem to health of the personnel working in theaters. The adverse effects of inhalational anaesthesia includes : Performance decrement, spontaneous absorption, altered sex ratio, still birth, infertility, cancer and organ toxicity, with so much contraindications of the use of nitrous oxide gas including : Middle ear surgery, lung cysts and prolon-

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ged abdominal surgery (1, 2). Many methods for scavenging these vapors and gases were introduced but none of them was perfect (3).

Total intravenous anaesthesia now gained a good popularity among anaesthesiologists aiming to protect themselves from the harmful effects of inhalational anaesthesia. In Iraq, the scarcity of anaesthetic liquids and gases, and sophisticated anaesthesia equipments had directed us to use total intravenous anaesthesia.

Ketamine is one of the drugs used for total intravenous anaesthesia as it has a good analgesic power with a good support of cardiovascular system, but it has the problems of emergence hallucination, hyperexcitability, overdosage and long recovery period (4, 5).

Many intravenous anaesthetic agents has been tried including midazolam, diazepam, thiopentone and fentanyl. Although these drugs when given toward the end of operation may reduce the emergence phenomena of ketamine, but they can cause a long recovery period (6) and ventilatory depression (7-9), unlike ketamine and droperidol in their clinical doses, does not cause respiratory depression (10).

In this study, diazepam, thiopentone and droperidol was chosen and tested in combination with ketamine.

The aims of this study were to find the best combination of intravenous anesthetic agents to overcome the above mentioned side effects of ketamine to be used for minor surgical procedures with spontaneous ventilation, and to find the safest method of total intravenous anaesthesia that can be used by anaesthesiologists assistants in disaster situation where there is a shortage of anaesthesiologists.

PATIENTS AND METHODS

Patients

Approval was obtained from the Ethical Committee, College of Medicine, University of Basrah, and patients were informed about the different steps of the study. Twenty-four adult patients, American Society of Anaesthesiologists (ASA) physical status class I & II were scheduled for elective minor surgery. They were randomly assigned into three groups namely : the diazepam group, the thiopentone group, and the droperidol group; each containing 8 patients as shown in table 1.

Methods

Hemodynamic changes including blood pressure & heart rate, respiratory functions including tidal volume and respiratory rate were monitored as follows : A base line record on arrival to the theater, post induction record, during surgery, and at the end of surgery. Arterial blood pressure was measured by sphygmomanometer and the mean arterial pressure was taken as equal to : Diastolic pressure + 1/3 (systolic - diastolic). Tidal volume and minute volume were measured by Wright spirometer connected to the face mask. The signs of adequacy of anaesthesia and intra-operative conditions assessed by the anaesthesiologist and the surgeon, total dose of ketamine, duration of surgery, recovery time, and the presence of emergence phenomena were also monitored.

ANAESTHESIA TECHNIQUE

All patients were premedicated with 0.6 mg atropine sulfate intravenously, and a ketamine drip was prepared as 0.1 % solution using IVAC electrically controlled infusion set.

Patients in the diazepam group, had induction of anaesthesia using 1 mg/kg.B.W. ketamine and 10 mg diazepam intravenously, and maintained with the 0.1 % ketamine drip. In the thiopentone group, patients were induced with 1 mg/kg ketamine and 4 mg/kg sodium thiopentone intravenously, and maintenance was carried on with 0.1 % ketamine drip. The droperidol group was induced with 1 mg/kg ketamine and 2.5

GROUPS	DIAZEPAM	THIOPENTONE	DROPERIDOL
No. of cases	8	8	8
Age (years) Mean ± SD	39.3 ± 9.2	26.6 ± 15.8	28.6 ± 7.2
Weight (kg.) Mean ± SD	69.4 ± 8.6	63.8 ± 10.8	78.1 ± 30.2
Sex : Male Female	 4 4	 5 3	 5 3
Operations : Types & Frequency	Hydrocele : 1 Breast mass : 2 Lipoma : 2 Skin graft : 2 Amputation : 1	Hydrocele : 1 Breast mass : 3 Lipoma : 2 Keloid rem. : 1 Amputation : 1	Hydrocele : 2 Breast mass : 2 Ganglion : 1 Skin graft : 1 Amputation : 2

Table 1 : Characteristics of patients participating in the study.

	DIAZEPAM	THIOPENTONE	DROPERIDOL
Total ketamine dose mg. (Mean ± SD)	298 ± 69	262.5 ± 134	200 ± 98*
Duration of surgery min. (Mean ± SD)	32.5 ± 3.8	33.1 ± 7.5	30.6 ± 12.7
Intraoperative conditions :			
Good	-	-	4 cases*
Fair	4 cases	3 cases	3 cases
Unsatisfactory	4 cases	5 cases	1 case*
Recovery time min. (Mean ± SD)	8.9 ± 8.6	14.3 ± 7.9	7.3 ± 3.6*
Emergence phenomena	2 cases	4 cases	No case*

Table 2 : Monitoring parameters in all groups. * : P < 0.05

	BASE LINE	POSTINDUC.	MAINTENANCE	SURG. END
Diazepam group				
Heart Rate (beat/min.) Mean ± SD	97 ± 15	107.3 ± 17	106.8 ± 14	104.5 ± 13
Mean Art. Press. (MAP) mmHg. Mean ± SD	97.5 ± 10	102.6 ± 13	102 ± 12	96.8 ± 8
Minute Volume (litre) Mean ± SD	7.35 ± 2	8.1 ± 2	8.6 ± 4	8.8 ± 3
Thiopentone group				
Heart Rate (beat/min.) Mean ± SD	110.8 ± 22	105.5 ± 14	107 ± 9	105 ± 14
Mean Art. Press. (MAP) mmHg. Mean ± SD	96.1 ± 13	101.3 ± 10	103.4 ± 18	96.5 ± 8
Minute Volume (litre) Mean ± SD	7.8 ± 2	8 ± 3	8.2 ± 2	7.8 ± 2
Droperidol group				
Heart Rate (beat/min.) Mean ± SD	94.5 ± 9	94.8 ± 16	91.3 ± 13	92 ± 12
Mean Art. Press. (MAP) mmHg. Mean ± SD	96.1 ± 12	108.1 ± 14	103.1 ± 13	100.5 ± 13
Minute Volume (litre) Mean ± SD	8.8 ± 3	8.9 ± 3	7.5 ± 2	7.2 ± 1

Table 3 : Vital signs changes during different stages of study.

mg droperidol intravenously, and also maintained with 0.1 % ketamine drip.

All patients were ventilated with 100 % oxygen through a face mask and oropharyngeal airway, and they were allowed to breath spontaneously. Ketamine drip maintenance was started at a rate of 300 ml/hour and increased when there were signs of inadequate analgesia including : Increased muscle tone or motor activity, lacrimation, and progressive increase of more than 20 % in the heart rate, respiratory rate and mean arterial pressure.

Statistical analysis of data were performed using Student t-test and standard normal deviate test (Z test), to test the significance between the records in each group and between the groups.

RESULTS

The three study groups were comparable with respect to ASA status, age, weight, sex, and type of surgical procedures as shown in table 1.

Table 2 showed that total dose of ketamine was significantly lower in the droperidol group (200 ± 98 mg) as compared with other groups, although the mean weight in the droperidol group was higher. The duration of surgery was comparable in all the groups. The intraoperative conditions were much better in the droperidol group as 7 out of the 8 patients had a satisfactory (good and fair) anaesthesia noticed by the anaesthe-

siologists and surgeons. The recovery time was significantly lower in the droperidol group (7.3 ± 3.6 min). Emergence phenomena was not noticed in any patient in the droperidol group, while it was higher in the thiopentone group (50 %) and in diazepam group (25 %).

Although droperidol group showed a higher intraoperative stability in regard to heart rate, minute volume and mean arterial pressure, but the statistical evaluation of the cardiovascular and respiratory changes did not reveal any significant difference within or between the groups, as demonstrated in table 3.

DISCUSSION

We, as anaesthesiologists, should accustom ourselves to the relatively new technique of total intravenous anaesthesia with the available intravenous anaesthetic agents, and train our assistants to use it, particularly in heavy casualty and disaster situation, where most of the surgical procedures are minor and can be done with spontaneous ventilation of 100 % oxygen through a face mask.

Although, it is often said «There is no safe anaesthetic agent, there is no safe anaesthetic technique, there is only safe anaesthetist», but this study endeavor to use a safe technique and anaesthetic agents by a least trained assistants or doctors.

The choice of continuous infusion technique versus intermittent bolus administration of ketamine has many advantages including; decrease of the drug dosage requirement, improve intraoperative conditions, and decrease recovery time (11).

This study found that, following I.V. atropine premedication to reduce excessive salivation produced by ketamine (12), the best combination for induction of anaesthesia was an intravenous 2.5 mg droperidol followed by 1 mg/kg ketamine, and maintenance with 0.1 % ketamine drip & 100 % oxygen given by face mask.
Excellent results were obtained in the droperidol group including : Minimal total ketamine dose (200 ± 98) which is significantly lower than diazepam and thiopentone groups, this will definitely reduce the side effects of ketamine. Intraoperative conditions were satisfactory in 7 out of 8 patients as confirmed by both the anaesthesiologist and the surgeon. The recovery time for anaesthesia was only 7.3 ± 3.6 minutes, which is significantly lower than other groups. The emergence phenomena which is a real problem in the use of ketamine had not been noticed in any of the patients of the droperidol group.

Although droperidol group showed a higher intraoperative stability in regard to heart rate, minute volume and mean arterial pressure, but the statistical evaluation did not expose any significant difference between the groups.

In the literature, droperidol was found to have the advantage of reducing the emergence phenomena of ketamine (13, 14), it also has the benefit of protection against epinephrine induced cardiac dysrhythmia, and it has a postoperative antiemetic effect (15).

Furthermore, to avoid the possibility of phlebitis and its complications, droperidol can be mixed with ketamine even in the same syringe, as the PH of droperidol solution is 3-3.8 and the PH of ketamine is 3.5-4.1 (16), while barbiturates or diazepam can not be mixed with ketamine (17).

In conclusion, droperidol was found to be a safe and efficient drug which should be present in any combination of total intravenous anaesthesia specially with spontaneous ventilation for minor surgical procedures for the above mentioned advantages.

SUMMARY

Because of the risk of atmospheric pollution in the theater, the lack of complex scavenging systems, the high cost and inavailability of inhalational anaesthetic agents, this study was designed to get the benefit of total intravenous anaesthesia.

Twenty-four patients were divided into three groups according to the induction combination of drugs : The diazepam group was induced with 1 mg/kg ketamine and 10 mg diazepam intravenously; the thiopentone group was induced with 1 mg/kg ketamine and 4 mg/kg sodium thiopentone I.V. simultaneously; the induction of droperidol group was accomplished with 1 mg/kg ketamine and 2.5 mg droperidol intravenously.

For all the groups, maintenance was achieved with 0.1 % solution ketamine drip using IVAC electrically controlled infusion set, with 100 % oxygen given through an oropharyngeal airway via a face mask.

The results of this study showed that giving droperidol 2.5 mg with ketamine 1 mg/kg intravenously, followed by 0.1 % ketamine drip, is the best method for total intravenous anaesthesia for minor surgical procedures with spontaneous ventilation. The advantages of this group over the others were : Reduction in total ketamine dose (only 200 ± 98 mg), good intraoperative conditions, short recovery time (7.3 ± 3.6 min), and no emergence phenomenon of ketamine. Also there was a high stability in regard to heart rate, mean arterial pressure and minute volume, with the other benefits of droperidol including antiemetic effect and protection against epinephrine induced cardiac dysrhythmias with no danger of phlebitis. It is therefore recommended to use I.V. 2.5 mg droperidol with 1 mg/kg ketamine for induction of total intravenous anaesthesia.

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References

1. Morgan M : Total intravenous anesthesia for major surgery. *M. E. J. Anesth.* 12:443-456, 1994.

2. Cohen E, Brown B, Bruce, D : Occupational disease in dentistry and chronic exposure to trace anesthetic gases. *J. Am. Dent. Assoc.* 101:21, 1980.
3. Gray W M : Scavenging equipment. *Br. J. Anesth.* 57:685-695, 1985.
4. White P F, Ham J, Way W : Pharmacology of ketamine isomer in surgical patients. *Anesthesiology* 52:231-239, 1980.
5. Appel E, Dudziak R, Palm D : Sympathoneuronal and sympathoadrenal activation during ketamine anesthesia. *Eur. J. Clin. Pharmacol.* 16:91-95, 1979.
6. Nishiyama T, Hirasaki A, Seto K : Total intravenous anesthesia midazolam-fentanyl Vs enflurane-nitrous oxide. *M. E. J. Anesth.* 12:457-467, 1994.
7. Clergue F, Desmonts J, Duvaldestin P : Depression of respiratory drive by diazepam as premedication. *Br. J. Anesth.* 53:1059-1063, 1981.
8. Morel D, Forster A, Bachmann M : Effect of intravenous midazolam on breathing pattern and chest wall mechanics in humans. *J. Appl. Physiol.* 57:1104-1110, 1984.
9. Germain M, Wahba W, Gillies D : Ventilation following induction of general anesthesia by thiopentone. *Can. Anesth. Soc. J.* 29:100-104, 1982.
10. Morel D, Forster A, Gemperie M : Noninvasive evaluation of breathing pattern and thoraco-abdominal motion following the infusion of ketamine or droperidol in humans. *Anesthesiology* 65:392-398, 1986.
11. White P : Use of continuous infusion versus intermittent bolus administration of fentanyl or ketamine. *Anesthesiology* 59:294-300, 1983.
12. Magbagbeola J : Ketamine-relaxant-air anesthesia for abdominal surgery in developing countries. *Br. J. Anesth.* 45:1217, 1973.
13. Dundee J : *Proc. R. Soc. Med.* 64:1159, 1971 from Synopsis of Anesthesia PP. 284, 1973, 7th ed., Lee J & Atkinson R, Wright-Bristol Press.
14. Oguchi K, Arakawa K, Nelson S : The influence of droperidol, diazepam, and physostigmine on ketamine-induced behavior and brain regional glucose utilization in rat. *Anesthesiology* 57:353-358, 1982.
15. Cohen S : Antiemetic efficacy of droperidol and metoclopramide. *Anesthesiology* 60:67-69, 1984.
16. Martindale : The extra pharmacopia, 29th ed. 1989. PP. 1120, 1128, 735 Royal Pharmaceutical Society.
17. Physicians Desk Reference : 44th ed. 1990. PP. 1616, 767. Medical Economics Company.