Titrated Total Intravenous Anaesthesia (TIVA) in War

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SUMMARY: In the Rama mobile war hospital, intravenous (IV) anaesthesia was used in 78 patients undergoing surgical procedures lasting 4-25 min. Boluses of thiopentone (Group 1), propofol (Group 2), propofol + alfentanil (Group 3), and ketamine + midazolam (Group 4) were used. Induction of anaesthesia, resulted in a mean blood pressure decreased about 15%. Apnoea of more than 20 sec was observed in Group 3, but no naloxone was required. Recovery was rapid enabling patients to maintain their own airway. The use therefore of titrated anaesthetics in war is considered acceptable.

Introduction

At the beginning of the war in 1991 the Croatian Medical Corps Headquarters was formed to provide health care for both soldiers of the newly formed Croatian Army and civilians in Croatia, and parts of Bosnia and Herzegovina (1, 2).

A number of mobile war hospitals were formed to provide frontline resuscitation and surgery for the wounded in Dalmatia (South Croatia) and the neighbouring parts of Bosnia and Herzegovina. The Split Clinical Hospital provided Field Surgical Teams (FSTs) and medical supplies to the mobile units and admitted the severely wounded for further treatment.

All emergency procedures excluding neurosurgical cases were performed in mobile hospitals using either inhalation anaesthetics (halothane, nitrous oxide) and/or IV anaesthetics (fentanyl, alfentanil, thiopentone, propofol and ketamine).

We report on titrated intravenous anaesthesia for quick surgical procedures taking 4-25 min, at the Rama mobile war hospital (3).

Patients and Methods

At the Rama war hospital near Prozor, Bosnia and Herzegovina, anaesthesia was provided for 674 wounded soldiers and civilians. Of these 78 patients, anaesthesia was maintained by titrated intravenous anaesthetics for procedures lasting 4-25 min. The patients were males, aged 19-43, ASA grade I and II. No patients received a premedication. First a vein on the dorsum of the hand was cannulated, although in 7 patients this could not be inserted due to injury to the upper extremity. In these

cases the external jugular or a lower extremity vein was cannulated. Fluid resuscitation was started. Pulse, blood pressure, and oxygen saturation were monitored. Blood pressure and pulse were also monitored before induction as well as during and after anaesthesia.

The patients were divided into four groups according to the anaesthetic administered. Thiopentone (3-5 mg/kg) was used in eight patients (Group 1), propofol (2.5 mg/kg) in 12 patients (Group 2), alfentanil in a bolus dose of 10-15 µg/kg + propofol (2.5 mg/kg) in 49 patients (Group 3), and ketamine (3.5 mg/kg b.w.) + midazolam (5mg) in nine patients with low blood pressure on admission (Group 4). Further doses of alfentanil, propofol and ketamine were titrated to the response required. Atropine (0.5-1.0 mg) was administered for bradycardia.

Results

Seventy eight patients underwent surgical procedures lasting less than 25 minutes and data for these patients are shown in Table 1. Propofol anaesthesia was used in 78.2% of the 78 patients.

The reasons for surgery are listed in Table 2. The majority of the patients had suffered injuries to the lower extremities. Table 3 shows the mean duration of anaesthesia and time to full recovery. The shortest duration of anaesthesia was recorded in the thiopentone group, and the longest in the alfentanil and propofol group. The recovery from anaesthesia was the longest with ketamine. There was no significant haemodynamic changes in any groups (Table 4). Apnoea following anaesthetic induction is shown in Table 5. Apnoea of more than 20 sec was most frequently observed in Group

3 (alfentanil + propofol). The occurrence of postoperative morbidity (vomiting, dreams) was most frequent in Group 4 (ketamine) (Table 6). There were no deaths during the study.

Table 1
General data of 78 male patients anaesthetised with titrated intravenous anaesthesia

Group		1 Thiopentone	2 Propofol	3 Propofol+ alfentanil	4 Ketamine + midazolam
N	(%)	8 (10.3)	12 (15.4)	49 (62.8)	9 (11.5)
Weight	(kg)	63-84	82-88	59-94	75-87
Age	(yrs)	21-25	20-44	19-39	27-34

Table 2
Reasons for Surgery

Injuries to lower extremities	43
Injuries to upper extremities	11
Injuries to gluteal region	6
Head injuries	4
Chest injuries	6
Perianal abscesses	8
Total	78

Table 3
Duration of anaesthesia and recovery

Duration (min)	Thiopentone	Propofone	Propofol + alfentanil	Ketamine + midazolam
Operation	4	5	14 (8-25)	12 (5-15)
Recovery	7 (5-9)	6	8 (10-15)	25 (17-35)

Table 4
Mean values of blood pressure and pulse during surgery

Group	1		2		3		4	
	BP	P	BP	P	BP	P	BP	P
Before anaesthesia	127/75	88	135/80	84	130/80	86	80/60	110
2 min after induction	115/70	93	125/75	84	125/70	80	85/60	110
5 min after induction	115/70	84	125/75	84	120/75	80	95/70	100
10 min after induction					130/75	80	95/70	100
15 min after induction					120/80	80	95/70	98

BP = Blood Pressure
P = Pulse

Table 5
Number of patients with apnea

Anaesthesia induced by	Apnea>20 sec	Apnea<20 sec	No apnea
Thiopentone	0	3	-
Propofol	1	4	4
Alfentanil+ propofol	12	9	28
Ketamine+ midazolam	0	0	0

Table 6
Postoperative side effects

Side effect	Thiopentone	Propofol	Propofol+ alfentanil	Ketamine+ midazolam	Total
Vomiting	1	0	6	2	9
Dreams	0	0	2	2	4

Discussion

The Rama mobile hospital near Prozor was located in a factory basement (3). The operating room was equipped with two operating tables each with an anaesthetic machine, ECG monitor and oximeter. In mass casualty situations minor surgical operations were performed in a side room. As ventilation was so poor the use of inhalant agents would undoubtedly have caused significant pollution. After resuscitation and surgery, patients were evacuated by road to Split Clinical Hospital, if weather conditions permitted. Total intravenous anaesthesia is suitable for many casualty scenarios, being simple, appropriate and adequate for surgery when a greater number of patients were admitted within a short period of time. The method provided a good recovery profile and eased casualty evacuations.

Other workers have also confirmed the slower recovery profile seen in the thiopentone group (4). Except for the ketamine group where the systolic blood pressure was maintained, the arterial pressure decreased by about 15% after the induction of anaesthesia. In other groups there were no significant changes in pulse rates. Although ketamine produces a tachycardia through central sympathetic stimulation, this effect can be abolished by the poor administration of midazolam (5). The absence of a major haemodynamic upset however could be attributed to the youth and physical state of the patients. Recovery from anaesthesia, was deemed to have occurred when the patient was able to give his name and year of birth. This was quickest in the propofol group and longest in the ketamine + midazolam group, possibly due to a synergistic action of the two drugs (6, 7). Recovery from midazolam and ketamine anaesthesia can be accelerated by the administration of flumazenil (8) or physostigmine

(9). Apnoea of more than 20 sec was recorded in 18% of the propofol alfentanil group probably opioid (10-12). As there was no respiratory depression in this group, naloxone was not deemed necessary. Side effects such as vomiting were rare, but dreams, noted in the ketamine group were probably attenuated to the co-administration of midazolam. Although a total intravenous infusion using a combination of opioids, ketamine and propofol could provide cardiorespiratory stability for major cases when the lack of infusion pumps prohibited its use (13).

However for quick procedures in mass casualty scenarios in war the use of total intravenous techniques has been shown to be simple and effective.

Further work needs to be done in finding better drug combinations and extending the use of TIVA in longer procedures.

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