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Anaesthesia at remote location: use of modified Bain circuit (Mapleson D) at Kunri Christian Hospital (KCH)

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Original Article

Anaesthesia at remote location: Use of Modified Bain Circuit (Mapleson D) at Kunri Christian Hospital (KCH)

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Abstract

Objective: To develop a safe general anaesthesia technique for remote areas with lack of facilities.

Methods: Four types of anaesthesia techniques using TIVA and modified Bain circuit were planned. Monitoring facility was limited to manual sphygmomanometer, palpation of radial pulse and monitoring of colour of skin and blood. Depth of anaesthesia was assessed using EVANs, RPST scoring system. Patients were asked in recovery room for awareness.

Results: Surgeries done were cesarean sections, laparotomies, gynaecological, urological, hernia and burn contractures. Six patients had RPST score of 5 or more and three patients in recovery room complained of awareness. Cost per Anaesthesia was Rs225.

Conclusion: TIVA with modified Bain circuit provided effective anaesthesia in remote area at low cost

Introduction

Shortage of Anaesthesiologist and Anaesthesia related facilities have been a major problem in under developed countries.[1] Many operations are performed by frontline doctors single handedly under Ketamine Anaesthesia without any airway protection and muscle relaxation. Due to low socioeconomic status, patients are unable to afford standard Anaesthesia care. The purpose of this paper is, to enlighten the efficiency of Modified Bain circuit.[2] This Modification was used for two months at Karachi Christian Hospital (KCH),

Kunri is small town of District Umerkot in the desert of Thar, approximately four hundred kilometer from Karachi, Pakistan. Kunri Christian Hospital was built by Christian missionaries and is the only hospital in the district where emergency and elective surgeries were managed. Laboratory facility caters solely for Haemoglobin and electrolytes. Operating room had one H size oxygen cylinder and no monitoring facility. Drugs available were Ketamine and Buprenorphine.

The objective of this study was to develop an anaesthetic technique which could provide safe general Anaesthesia for patients in remote areas where no anaesthesia equipment facility was available. To access the effectiveness of a newly designed modification of Bain breathing circuit which would provide low cost Anaesthesia.

Patients and Methods

All patients scheduled for surgeries were assessed preoperatively. Only laboratory facility available in emergency was haemoglobin and electrolytes. Before visiting Kunri Christian Hospital, information was gathered about the type of surgeries performed, so that an anaesthesia technique could be planned and suitable drugs for anaesthesia and resuscitation arranged. Majority of the cases were emergency caesarean sections and laparotomies. Less frequently patients were operated for urinary bladder stones. Anaesthesia techniques were planned for emergency and elective procedure, both in the major and minor category. Versatile non rebreathing modification of Bain system was used (Figure). A non-rebreathing ambu-E valve was attached at the patient's end of the Bain circuit. The reservoir bag and adjustable pressure-limiting valve were replaced by a self-inflating Ambu bag connected to Bain circuit by corrugated tube. Compressed oxygen from a cylinder was delivered via a plastic tube to inner coaxial tube of the system; functionally this was a unidirectional flow system using the outer coaxial tube of the Bain system as the fresh gas reservoir. This design provides ambient air supplementation of the inspired gases without any anaesthesia machine. To our knowledge, Bain circuit has not been used directly with oxygen cylinder previously.

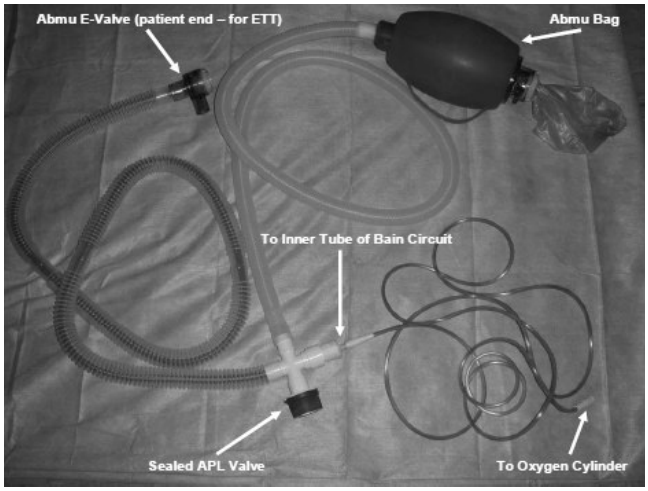

Figure: Modified Bain Circuit for ambient air-oxygen inhalation.

Four different types of anaesthesia techniques were used. Technique 1 was for Caesarean sections. It included rapid sequence induction with Thiopentone, 2 mg/kg, Ketamine, 1 mg/kg and Suxamethonium, 1 mg/kg IV followed by endotracheal intubation. Anaesthesia was maintained with Ketamine, 2 mg/kg/hr along with Pancuronium, 0.1 mg/kg boluses as required and the lungs were manually ventilated with air-oxygen using modified Bain circuit. After delivery of the baby, Diazepam 0.1 mg/kg and Buprenorphine, 2.5 µg/kg were administered. Ketamine infusion was stopped approximately 20 minute before completion of surgery. At the end of the surgery, patients were reversed with neostigmine, 2.5 mg and atropine, 1 mg. Trachea was extubated and patient was shifted to recovery room.

Technique 2 was used for patients requiring intubation and muscle relaxation. They were induced with Diazepam, 0.2 mg/kg, Buprenorphine, 2.5 µg/kg Ketamine, 2 mg/kg and suxamethonium, 1mg/kg. Patients were maintained with Ketamine infusion, 2 mg/kg/hr, pancuronium, 0.1 mg/kg boluses and lungs were manually ventilated with modified Bain circuit with air-oxygen mixture. Rest of the technique was similar to the first one.

Technique 3 was used for patients requiring general anaesthesia without endotracheal intubation. Induction was done with diazepam, 0.2 mg/kg, buprenorphine, 2.5 µg/kg and Ketamine, 2 mg/kg. During the maintenance phase, patients received air-oxygen through modified Bain circuit using face mask and breathing spontaneously.

In the 4th anaesthesia technique, spinal or epidural anaesthesia was planned. Monitoring was done by taking manual blood pressure using mercury sphygmomanometer every 5 minutes, continuous palpation of pulse, colour of skin and blood, urine output where indicated and patients were accessed during surgery for the depth of anaesthesia using EVANS RPST scoring system.[3] This system uses heart rate, systolic blood pressure, sweating and tears on a scale of 0 - 2 for each parameter. Any patient could achieve a score ranging from 0 - 8 with higher score indicating light anaesthesia. A score of 5 and above was considered to be associated with inadequate depth of anaesthesia and an additional bolus of IV anaesthetic was given and infusion rate was increased to achieve a score of 5 or less. In the post operative period, time taken to become responsive to verbal command after discontinuation of Ketamine infusion was noted and patients were asked specifically about awareness during surgery.

Result

During two months period at Kunri, 73 patients received anaesthesia of which 36 were elective and 37 were emergencies

Table-1: The Distribution of Elective and Emergency Procedures in Different Techniques.

Anaesthesia Technique	Elective	Emergency	Total
1	1	25	26
2	17	9	26
3	11	0	11
4	7	3	10
Total	36	37	73

(Table 1). Twenty-six patients received anaesthesia according to technique 1, 26 according to technique 2, 11 according to technique 3 and 10 patients received regional anaesthesia (technique 4). Thirty patients had Caesarean section, 26 with technique 1 and 4 under regional. Seven laparotomies were done with technique 2, 17 procedures related to gynecological and urological surgeries were performed out of which 8 were by technique 2, 5 by technique 3 and 4 by technique 4. Three inguinal hernias were done, 1 by technique 1 and 2 by technique 2. Thirteen patients received general anaesthesia for wound debridment and dressings. Three patients with burn contractures received anaesthesia technique 2 (Table-2). Table-3 shows the EVANS score used to monitor the depth of anaesthesia. In hearts criteria, 30 patients had a score of 0, 20 had a score of 1 and 4 had a score of 2, and similar scores are given for systolic blood pressure, sweating and tears. A total of 6 patients had EVANS score of 5. Three patients complained of awareness in the postoperative period out of which 1 had EVANS score of greater than then 5. Time taken by majority of patients to become responsive to verbal commands after discontinuation of Ketamine infusion was in the range of 15 to 35 minutes. The average cost for general anaesthesia per patient was approximately 225 PKR with maximum cost in technique 1 (average 375 PKR) and minimum in regional technique (average 90 PKR). This price did not include the price of oxygen.

Table 2: Distribution of procedures and anaesthesia technique used.

Procedure	Technique 1	Technique 2	Technique 3	Technique 4	Total
Cesarean Section	26			4	30
Laparotomy		7			7
Gynaecology & Urology		8	5	4	17
Inguinal Hernia	1	2			3
Wound Debridement		7		6	13
Burn Contracture		3			3
Total	27	27	5	14	73

Table 3: Depth of anaesthesia EVANS Score.

EVANS Score	Heart Rate	Systolic Blood Pressure	Sweating	Tears
0	39	40	55	56
1	20	16	6	4
2	4	2	2	3

6 patients had score of 5 or more.

Discussion

In twenty first century when specialty of anaesthesia is using high-tech computer technology, in developing countries there are still places where surgeries are being done without any anaesthetist, anaesthesia machine and monitoring facilities,[1] which for most of anaesthesia community in the developed world is beyond the scope of imagination. Thar dessert is located in the East of Pakistan extending into India, where even basic life facilities i.e. water and communications are scarce. KCH only had beds, very few doctors and very basic investigation facility. Operating theatre was a room with operating table and one H size oxygen cylinder. We took the initiative to design a technique which could be offered to such an illequipped hospital of an underdeveloped area. Kunri covers a huge area in the dessert with very scattered population living in far off places. By the time patients reach hospitals they would have been sick for many days, especially pregnant women would have been in obstructed labour for days and when they reached the hospital, they were very dehydrated, septic and anaemic. We planned four different anaesthetic techniques for different kind of patients and surgeries.

Technique 1 was planned for C-sections. Thiopentone in combination with Ketamine was given for induction,[4,5] as these patients were very sick and needed urgent management and were not able to sustain the drop of blood pressure associated with Thiopentone alone. Ketamine alone was not used as sole agent to avoid the psychosomatic side effects. Patients were maintained on Ketamine infusion[6] of 2 mg/kg/hr through a paediatric infusion burette and bolus of 0.2 mg/kg was given if patients had Evans score greater than 5. Ketamine infusion was stopped 20 minutes before the closure of skin, a practice adopted from previous observations[6] which showed that if infusion was discontinued earlier at 10 minutes before the completion of surgery, patients were unresponsive for a prolonged period. Patients were maintained with air-oxygen mixture given through modified Bain circuit,[2] to which we made another modification by attaching endotracheal tube connector at the

machine end of the circuit, so that it could be used with oxygen cylinder by using a long tubing and 4 liters oxygen flow.[5] The facility of pulse oximeter was not available. This circuit was very effective as no change was noted in patients colour of skin or blood. Though a very crude method of monitoring saturation, but there was no other option.

Depth of anaesthesia was monitored using Evans RPST scoring[2] and 3 patients complained of awareness but only one had Evans score positive. Evans was positive in six patients but only one complained of awareness, so Evans RPST score was not found to be very effective in determining depth of anaesthesia.[7] Most of our patients had excessive salivation due to use of ketamine but we could not give atropine as premedication due to the very hot weather.

Out of 25 emergency C-sections performed, 8 patients ended up with hysterectomy. Most of these patients had obstructed labour for days and uterus did not contract after delivery. Six patients had still birth. Average haemoglobin of patients coming for C-section was 7 gm/dl with some of them having 5 gm/dl. In emergency, group specific blood was transfused as soon as the blood group was done. Fortunately none of our transfused patients had adverse effects of uncrossed matched blood transfusion. Our technique was very economical with approximately 225 PKR (about 4 USD) per case.

In conclusion, we consider our techniques suitable in view of type of patients and facilities available. Patients remained haemodynamicaly stable (within 20% of their baseline values). Modified Bain circuit was effective and techniques very economical. We recommend this modification of Bain circuit and anaesthetic techniques which can be used in emergencies as wars and in situations like Tsunami and recent earthquake in Pakistan, where anaesthetic equipments and monitoring facilities are not easily available.

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