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The Effects of Hypotensive Anaesthesia on Reducing Intraoperative Blood Loss, Duration of Operation and Quality of Surgical Field During Orthognathic Surgery in a Tertiary Care Hospital

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Abstract **Original Research Article**

Background: Hypotensive anaesthesia is a method of reducing the blood pressure of a patient at some point of surgical treatment to reduce the quantity of blood loss. This is the most frequently used approach in microvascular surgery however it can be used in a wide range of surgeries. The efficacy of hypotensive anaesthesia is decreasing intraoperative blood loss, lowering operation time and enhancing the quality of surgery. ***Objectives:*** The aim of the study is to assess the effects of hypotensive anaesthesia on reducing intraoperative blood loss, duration of operation and quality of surgical field during orthognathic surgery in a tertiary care hospital. ***Methods:*** The study was carried out in the Anaesthesiology Department of Dhaka Dental College and Hospital, Dhaka, Bangladesh from July 2021 to December 2022. A prospective, randomized clinical research with 72 individuals was conducted. They were assigned at randomization to either a normotensive or a hypotensive anaesthesia group. ***Results:*** The mean blood loss for surgeries carried out under normotensive anaesthesia was 276.66±57.50 ml, whereas the mean blood loss for surgeries carried out under hypotensive anaesthesia was 162.50±37.25 ml. In the normotensive and hypotensive groups, the mean duration of operation was 195.83±60.44 minutes and 195±58.05 minutes respectively. ***Conclusions:*** Reducing intraoperative blood loss is really a benefit of hypotensive anaesthesia. As a standard method for orthognathic surgery, hypotensive anaesthesia can be justified for less blood loss and enhancing the quality of surgical field.

Keywords: Hypotensive anaesthesia; blood loss; Orthognathic surgery.

INTRODUCTION

Hypotensive anaesthesia is a technique used during surgery where blood pressure is reduced in a predictable and deliberate way. It was initially proposed for intracranial surgery by using Harvey Cushing in 1917 [1]. Gardner in 1946 carried out arteriotomy to reduce blood pressure for the duration of a surgical procedure to enhance visibility of the surgical field [2]. Since then, numerous methods of hypotensive anaesthesia has been used in more than a few surgical disciplines such as neurosurgery and orthopedic surgery.

In 1961 Enderby published a report on mortality and morbidity following hypotensive anaesthesia which involved 9,107 patients during the period of 1950-1960 [3]. In 1976 Schaberg *et al.*, reported the first medical study involving the impact of hypotensive anaesthesia on reduction of blood loss for maxillofacial surgery. In Schaberg's study, blood loss was reduced by about 44% when sodium nitroprusside was used to induce hypotension [4].

Orthognathic surgical procedure is broadly acknowledged for the correction of dentofacial deformities. Significant bleeding from both the incised soft tissues and bones might happen during orthognathic surgery because of the abundant blood supply in the head and neck region. Because of the inherent dangers related to allogeneic blood transfusion, hypotensive anaesthesia has been widely accepted as a means of lowering intraoperative blood loss and enhancing the quality of surgical field. In 2008 in a systematic review, W S Choi *et al.*, showed the risks

and benefits of deliberate hypotension in anaesthesia [5] Hypotensive anaesthesia was once justified as a routine method in orthognathic surgery, especially for bimaxillary osteotomies.

In performing hypotensive anaesthesia, the patients' age, previous medical records and preoperative blood pressure need to be taken into consideration. While some authors counseled a vary of mean arterial pressure between 50-65 mmHg as the goal for hypotensive anaesthesia, some endorsed an intraoperative MAP 20-30% below the patient's common MAP with a minimal of 50 mm Hg in ASA class I patients [6].

A wide range of medical trials have been suggested in the literature related to the outcomes of hypotensive anaesthesia on blood loss, operation time and high-quality of surgical area for orthognathic surgery [7]. The analysis of randomized control trials was once carried out to reply the following questions: "How effective is hypotensive anaesthesia in lowering intraoperative blood loss, enhancing the quality of surgical field and decreasing the operation time at some stage in orthognathic surgery? Does hypotensive anaesthesia reduce the blood transfusion rate in orthognathic surgery?" [8] The aim of this study is to assess the effects of hypotensive anaesthesia on reducing intraoperative blood loss, duration of operation and quality of surgical field during orthognathic surgery.

METHODS

The study was carried out in the Anaesthesiology Department of Dhaka Dental College and Hospital. The duration of this study was from July 2021 to December 2022. This prospective, randomized clinical anaesthetic trial involved 72 individuals who underwent orthognathic surgery. The study was conducted to assess the effects of hypotensive anaesthesia on reducing intraoperative blood loss, duration of operation & quality of surgical field during orthognathic surgery. Male & female patients between the age of 18 and 35 years having the criteria of American Society of Anesthesiologists (ASA) physical status I who needed orthognathic surgery were enrolled in this study. Patients under the age of 18 years old and above the age of 35 years old, having ASA physical status II, III, IV, V, VI were excluded from this study. During preanaesthetic checkup patients were selected according to the inclusion criteria and systolic blood pressure, diastolic blood pressure, mean arterial pressure & body weight were recorded with other preoperative parameters those are necessary for safe anaesthesia & recovery. Patients were divided into two groups - Normotensive patients' group & Hypotensive patients' group to compare the effect of hypotensive anaesthesia. Irrespective of gender 36 patients were included in each group. Informed written consent was taken from all the patients involved in this study. The anaesthesiologist was the only person who knew in which group each patient had been allocated to. In both group diazepam 5mg was given as premedication. Before induction systolic blood pressure, diastolic blood pressure, mean arterial pressure was measured in each patient. Central venous catheterization and intraarterial cannulation was done before induction. After preoxygenation induction was done by using propofol 2mg/kg body weight and nasotracheal intubation was done by using suxamethonium 2mg/kg body weight. General anaesthesia was maintained with mixture of oxygen, nitrous oxide and isoflurane during intraoperative period. Vecuronium bromide was used intermittently as intermediate muscle relaxant and patient was kept in Intermittent Positive Pressure Ventilation.

In Hypotensive patients' group Esmolol 0.5-1mg/kg body weight IV over 15-30 sec followed by 50-300µgm/kg/min and Glyceryl trinitrate 0.2-5 µgm/kg/min through infusion pump was used to maintain the mean arterial pressure in between 50-60 mm Hg. At each incision site all patients received 3ml of 2% lignocaine mixed with 1:200000 adrenaline. Electrocardiogram, end tidal carbon dioxide, pulse oximetry were used for intraoperative monitoring. Catheterization was done in all patients to monitor urine output. Throughout the procedure invasive blood pressure was monitored and recorded. The same single observer estimated the surgical blood loss each time. A videotape was used to record the duration of surgery from the beginning of the mucosal incision to the moment the osteotomy was performed. The surgical time was completely free of instrument passing and video positioning delays. A third party who was not aware of the study groups evaluated the videotapes after the study was over. Prior to the surgery and at the completion of the surgical period, all sponges and suctioning tools, including the bottles and tubing were weighed. All irrigation fluid was administered using 50-mL syringes that were calibrated in milliliter and the dosage was recorded properly. Collected data were entered and analyzed according to the objectives and variables by IBM software- Statistical package for Social Science (SPSS 24) version. Ethical clearance was taken from the IRB of the institution.

RESULTS

Total 72 randomized control trials were included in this study. Table 1 shows the demographics of the patients. Among the 72 patients, irrespective of gender 36 patients were included in Normotensive patients' group and 36 were included in Hypotensive patients' group. The Normotensive patients' group included 16 male and 20 female; the Hypotensive patients' group included 15 male and 21 female. All the patients of both groups were in the age range of 18-35 years old. In the normotensive group the weight ranged

from 40 to 75 kg, while in the hypotensive group, it was 38 to 70 kg. (Table 1)

Table 1: Demographics of the patients (n=72)

	Normotensive patients' group (n=36)	Hypotensive patients' group (n=36)
Age (in year)	25 (18-35)	25 (18-35)
Weight (kg)	54 (40-75)	55 (38-70)
Male	16	15
Female	20	21

Data are expressed as median (range)

Table 2 describes the preoperative and intraoperative blood pressure of the patients. In Normotensive patients' group preoperative systolic blood pressure was 113.50±6.50 mmHg, diastolic blood pressure was 81.50±4.75 mmHg and mean arterial pressure was 92±6.20 mmHg. In Hypotensive patients' group preoperative systolic blood pressure was 119.50±6.50 mmHg, diastolic blood pressure was 79.25±4.50 mmHg and mean arterial pressure was 93±4.80 mmHg. During intraoperative period, in Normotensive patients' group systolic blood pressure was 115.50±7.30 mmHg, diastolic blood pressure was 61.70±5 mmHg and mean arterial pressure was 79.63±4.20 mmHg, whereas in Hypotensive patients' group systolic blood pressure was 75.40±5.70 mmHg diastolic pressure was 44.95±5 and mean arterial pressure was 55.10±2.20 mmHg. (Table 2).

Table 2: Preoperative and Intraoperative blood pressure of the patients (n=72)

Type of Blood Pressure	**Preoperative blood pressure**		**Intraoperative Blood Pressure**	
	Normotensive patients' group (n=36)	**Hypotensive patients' group (n=36)**	**Normotensive patients' group (n=36)**	**Hypotensive patients' group (n=36)**
Systolic blood pressure (mm Hg)	113.50±6.50	119.75±6.50	115.50±7.30	75.40±5.70
Diastolic blood pressure (mm Hg)	81.50±4.75	79.25±4.50	61.70±5	44.95±5
Mean Arterial Pressure (mm Hg)	92±6.20	93±4.80	79.63±4.20	55.10±2.20

Data are expressed as mean±SD

Table 3 describes the intraoperative blood loss and duration of surgery in both groups. In Normotensive patients' group, the mean blood loss was 276.66±57.50 ml, whereas in Hypotensive patients' group, it was 162.50±37.25 ml. The mean duration of surgery in Normotensive patients' group was 195.83±60.44 minutes and in Hypotensive patients' group the duration of surgery was 195±58.05 minutes (Table 3).

Table 3: Intraoperative blood loss and duration of surgery

Name of Surgery	**Number of cases**		**Duration of Surgery Mean (Minutes)**		**Blood Loss Mean (ml)**	
(i) BSSO (Bilateral sagittal Split Osteotomy) with Mandibular Advancement	10	10	170	165	240	125
(ii) BSSO (Bilateral sagittal Split Osteotomy) with Mandibular set back	8	9	175	180	235	135
(iii) BSSO (Bilateral sagittal Split Osteotomy) with Mandibular Advancement with Genioplasty	3	2	200	195	255	140
(iv) Lefort I Osteotomy with maxillary advancement	7	6	155	165	275	180
(v) Lefort I Osteotomy with Maxillary set back	5	4	160	155	265	170
(vi) BSSO (Bilaterall Sagittal Split Osteotomy) with Lefort I Osteotomy	3	5	315	310	390	225
Total	36	36				
(Mean±SD)			195.83±60.44	195±58.05	276.66 ±57.50	162.50 ±37.25

* Data provided in this chart is medium and Mean±SD.

DISCUSSION

This present analysis is intended to summarize the results of available comparative randomized controlled trials on the efficacy of hypotensive anaesthesia on reducing intraoperative blood loss, decreasing operation time and improving the quality of surgical field within the context of orthognathic surgery. It was predicted that using hypotensive anaesthesia would reduce the requirement for blood

transfusions following orthognathic surgery. The mean arterial pressure is reduced by 30% from its preoperative value during controlled hypotensive anaesthesia and maintained it at that range during the surgical period [9]. Hypotensive anaesthesia is shown to improve the quality of surgical field in orthognathic surgery. While some authors believe hypotensive anaesthesia can reduce bleeding, improve the visibility of the surgical field. As a result, the operation time is reduced; however, no reduction in operation time was observed in orthognathic surgery under hypotensive anaesthesia [10-12]. One likely explanation for this finding is that the operation time for orthognathic surgery is no longer completely dependent on the quality of the surgical field but on several other important factors such as the complexity of the osteotomy design and the surgical skill of the operating surgeon.

Patients having double-jaw surgical treatment are at increased threat for blood loss than those having single-jaw techniques. It is additionally stated that LeFort I osteotomy contains a greater hazard for bleeding than mandibular osteotomies and may also fluctuate with specific surgical methods [12]. To determine the reduction of intraoperative blood loss, assessment of individual of research with comparable types of osteotomies were performed. Hypotensive anaesthesia successfully reduced intraoperative blood loss during double-jaw surgery. Hypotensive anaesthesia, however, did not substantially decrease blood loss in anterior maxillary osteotomy [13]. While hypotensive anaesthesia did not appear to minimize operation time for orthognathic surgical treatment as proven in this analysis. Several studies have found that operation time is significantly related to increased intraoperative blood loss [14]. Despite hypotensive anaesthesia, blood loss will rise significantly as the operation time is extended.

The use of local anaesthetics no longer solely presents pain relief and soft tissue hemostasis, it can additionally limit the physiological stress responses to the patient through orthognathic surgical treatment. Previous study revealed that for young and healthy patients, controlled hypotension with a mean arterial pressure of 50–65 mmHg is safe [15, 16]. The hypotensive group in this study had a mean arterial pressure of 55 mmHg. The study findings showed that using hypotensive anaesthesia, intraoperative blood loss is reduced but there was no statistically significant reduction in operating time. Another study also demonstrated that hypotensive anaesthesia did not reduce the operation time for surgery, it enhance the surgical environment [17]. For this finding, an explanation may be the fact that the duration of any surgery depends on a number of factors, including the complexity of the osteotomy pattern and the surgical skill of the surgeons. Furthermore, no single oral and maxillofacial surgeon performed all the operations that were involved in this study. Different surgeons have their own particular surgical methods, experiences and skills that can influence the duration of surgery and amount of blood loss throughout the procedure.

Controlled hypotensive anaesthesia has the benefits of significantly reduced blood loss, better surgical field visualization, preservation of donor blood, less need for blood transfusions and increased accuracy of surgery [18, 19]. As in other investigations, volumetric and gravimetric methods were used to evaluate blood loss [20]. The quantity of irrigation used was strictly monitored. Severe cardiovascular and respiratory conditions are common reasons to avoid using hypotensive anaesthesia [10, 18]. Patients who need orthognathic surgery are typically young and healthy and do not typically fall under these contraindications.

Additionally, compared to when normotensive general anaesthesia was performed, hypotensive general anaesthesia resulted in a 40% decrease in the volume of whole blood loss and a 44% decrease in the volume of red blood cells loss [4]. Numerous studies demonstrate a marked decrease in the requirement for blood transfusion when hypotenive anaesthetic technique was used. The results of this study demonstrate that in young, healthy adults undergoing elective orthognathic surgery, induced hypotensive general anaesthesia is safe and provides good control of blood loss [21-23].

Limitations of the Study

The present study was conducted in a very short period due to time constraints and funding limitations. The small sample size was also a limitation of the present study.

CONCLUSION

Hypotensive anaesthesia reduced blood loss significantly during orthognathic surgery and increased surgical patient satisfaction. It used to be believed that hypotensive anaesthesia helped to reduce operation time of orthognathic surgery procedures. Hypotensive anaesthesia is most beneficial during a lengthy procedure if a large volume of blood loss and subsequent blood transfusion are predicted. It is mandatory to do a thorough preoperative assessment and proper constant monitoring of the patients. So, hypotensive anaesthesia can be highly recommended in healthy orthognathic patients in order to minimize blood loss and improve the surgical field.

RECOMMENDATION

This study can serve as a pilot to much larger research involving multiple centers that can provide a nationwide picture, validate regression models proposed in this study for future use and emphasize points to ensure better management and adherence.

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DECLARATION

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Conflict of Interest: None declared.

Ethical Approval: The study was approved by the ethical committee of Dhaka Dental College and Hospital, Dhaka.

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