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Research Article

The Role of Hypotensive Anaesthesia in Reducing the Need for Blood Transfusion Following an Orthognathic Surgery – An Observational Study

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Abstract:

Objective: The purpose of the present study is to assess the amount of blood loss during orthognathic surgery when nitro glycerine is induced as hypotensive anaesthesia and also to compare the pre and postoperative haemoglobin, haematocrit and means arterial pressure levels.

Material and Method: 10 young orthognathic patients were included in this study, who were operated under hypotensive anaesthesia. The orthognathic surgery included and evaluated in the present study includes Anterior maxillary osteotomies (n=6), Lefort I osteotomy (n=1), Bilateral Sagittal Split Ramus Osteotomy (n=3), Sub apical osteotomy (n=1), Genioplasty (n=3). Pre and Postoperative haemogram, intraoperative blood loss and the duration of surgery were the parameters studied. Statistical analysis was performed using SPSS version 19.

Result: None of the patients included in the study required blood transfusion. Blood loss levels ranged from 77.60 ml to 283 ml. The mean surgical duration was 174 min, ranging from a minimum of 75 min to a maximum of 290 min. There was a fall in the mean Haemoglobin levels by 2.08 gm% and haematocrit and Red Blood Cell levels by 7.30% and 6.24% respectively.

Conclusion: Blood transfusion in Orthognathic surgery can be prevented by using Nitroglycerine as a hypotensive anesthetic agent. It also reduces surgical timing by improving the quality of the surgical field. Anyways further more clinical studies should be carried out to precisely conclude that nitroglycerine is an ideal agent for Orthognathic surgery.

Keywords: *Orthognathic surgery- Hypotensive anaesthesia- blood loss – haemoglobin - haematocrit - Mean arterial pressure.*

Introduction

Orthognathic surgery is one of the gold standard surgical alternative for rectifying the dental and bony deformities in terms of its stability, less relapse and well-being of the patients. Due to its enriched and entangled vascularity in the soft and hard tissues of the facial region, profuse bleeding is not readily manageable by usual haemostatic techniques, especially when it involves both the soft and hard tissues with major capillaries during incision and bone guttering, as a result of which there arises a need for transfusion. Blood transfusion is associated with various risks factors including transmission of transmissible infections like AIDS, hepatitis A, B, C, malarial or toxoplasmic infections, anaphylactic reactions and immune sensitization. Following precautions are taken to diminish the likely chance for such transfusions. One among them is hypotensive anaesthesia. Deliberate hypotensive anaesthesia with arteriotomy was first reported by Gardner to reduce arterial blood pressure and here by providing a blood less field during surgery in 1946 [1]. Since then, various strategies were used for inducing hypotension during surgery have been practiced in prolonged bone and brain surgeries, and the technique was first used in maxillofacial surgery by Schaberg et al. In 1976 [2].

To narrow down the intraoperative blood loss and to minimize the need for blood transfusion, deliberate and supervised use of hypotensive anaesthesia is administered during general surgical procedures including head and neck corrective surgeries. Besides, it is proclaimed to revamp the quality of the surgical field, but the operative time remains the same. The induction and maintenance of controlled moderate hypotension (CMH) levels has become a salient part of a major orthognathic surgeries involving osteotomy of the face [3]. Innumerous pharmacological agents have been used for inducing hypotension during maxillofacial surgeries indeed to reduce extra osseous and medullary blood loss to eliminate the need for homologous blood transfusion. Hence the study aims at the assessment of the amount of blood loss during Orthognathic surgery when nitroglycerine is administered as an induction agent for hypotensive anaesthesia and also to compare the pre & post-operative values of haematocrit, haemoglobin, Mean Arterial Pressure (MAP) and Red Blood Cell (RBC) count.

Materials and Methods

The present study was conducted in the Department of Oral and maxillofacial surgery, from 2010 September to 2012 December, at Ragas Dental College and Hospitals, Chennai. The study design was approved by the Institutional Review Board. The study comprised of 10 Orthognathic surgery cases (5 male and 5 female patients) with the patients' age ranging from 18 – 27 years. The complete procedure of the Orthognathic surgery to be done was explained clearly to the patient and the guardian and a written informed consent was obtained. General physical examination of the patients was carried out and the medical status was evaluated and healthy individuals were included in this study. Patients with known connective tissue disorder, Cardiovascular, renal, respiratory and hepatic disorder, haemostatic disorder, or diasthesis were excluded from the study. Patient's relevant information included were age, sex, chief complaint, relevant medical history and dental history, clinical findings, blood investigations, radiographic findings, and cephalometric findings were recorded.

Patient's prime complaint was attended primarily. The Orthognathic surgeries included and evaluated in the present study are Anterior Maxillary osteotomy (n=6), Lefort 1 osteotomy (n=1), Bilateral Sagittal Split Ramus Osteotomy (n=3), Sub-apical Osteotomy (n=1) and Genioplasty (n=3). The Blood Pressure, Pulse rate, haemoglobin, and haematocrit values were obtained prior and after the Orthognathic surgery for comparison. The hypotension anaesthesia was administered after the local anaesthesia. The amount of blood loss during the surgery was evaluated and the duration of anaesthesia and surgery were also recorded.

Patient preparatory methods

2ml of blood was withdrawn from the Brachial Vein and cross matching was done in VHS blood bank. One unit of whole blood was booked for the surgery. All patients were Nil-Per oral for 6 hours before the surgery.

Medications

Pre-medications were injected to the patient intra-muscularly 30 minutes before the surgery. Induction anesthesia was given and the patients were intubated by cuffed nasoendotracheal tube. Anaesthesia was maintained using N_2O and O_2 and long-acting muscle relaxants. Throat pack was placed using a ribbon gauge of standard length. Intra-oral nerve block was given using Lignocaine in all the cases before incision. Patients were given Nitroglycerine hypotensive anaesthesia diluted in DNS solution (Figure. 1) before the osteotomy cut was performed. The Mean arterial pressure was maintained around 70 mm/Hg till the osteotomy fragments were fixed. Regular antibiotics and other supportive medications were administered intravenously. Nitroglycerine was slowly reduced and Anaesthesia was withdrawn by giving reversal dose of Inj. Neostigmine and Glycopyrrolate. Hemostasis was checked. The complete list of medications used throughout the surgery along with their dosage and mode and time of delivery is enlisted in (Table 1).

Table 1 - Enlists the medications used throughout the surgery along with their dosage and mode and time of delivery.

	Medication	Dosage	Mode of delivery	Time of delivery
Pre - Medication	Inj. Fortwyn	0.6 mg/kg	Intra muscular	30 mins prior the surgery
	Inj. Phenergan	0.5 mg/kg		
	Inj. Glycopyrolate	0.04 mg/kg		
Induction anaesthesia	Inj. Thiopentone	5mg/kg	Intra venous	Start of surgery
	Inj. Succinyl Choline	1-2mg/kg		

Anaesthesia maintenance	N2O and O2	60 : 40 ratio	Inhalation	During surgery
	Inj. Vercuronium bromide	0.08mg/kg	Intra venous	
Local anaesthesia	2% lignocaine HCl with 1: 2,00,000 adrenaline	7 mg/kg	Intra oral nerve block	Before incision
Hypotensive anaesthesia	Nitroglycerine in DNS	3 – 10 mcg/kg/min	Intra venous	During surgery
Routine medications (antibiotics)	Inj. Taxim	1 gm	Intra venous	Pre and post operative
	Inj. Metrogyl	500 mg		
	Inj. Decadron	8 mg		
	Inj. Rantac	50 mg		
	Inj. Emeset	4 mg		
Pain killer	Inj. Voveron	3cc	Intra Muscular	Post operative
Reversal	Inj. Neostigmine + Glycopyrolate	0.05 - 0.07 mg/kg	Intra venous	Post operative

Inj- Injection ; mg- Milligrams ; kg – Killograms ; min – Minutes; gm- Gram ; cc- Cubic centimetre ; mcg- Microgram ; N_2O_2– Nitrous oxide ; O_2 - Oxygen ; HCl – Hydrochloride ; DNS- Dextrose normal saline

Calculations

VITALS

Intra-operative monitoring of vitals was done using Electrocardiography, Blood pressure apparatus, Pulse oximetry (Figure.2), and Heart rate monitor. Continuous monitoring of Blood pressure was done using oscillometry. Mean arterial pressure (MAP) was noted.

[MAP = diastolic pressure + 1/3 of pulse pressure].

DURATIONS

The duration of anaesthesia was recorded from the administration of induction anaesthesia to the reversal and the duration of surgery was recorded from incision to the last suture.

BLOOD LOSS

A single observer measured blood loss after every surgery. It was measured by reducing the amount of saline used, from the volume of fluid in the suction unit [A]. The weight of dry gauze was deducted from the weight of the blood-soaked gauze [B]. 1 gm of weight was considered 1 ml of blood (Figure. 3&4).

Total blood loss = Sum of blood drained in the suction unit and blood from gauze [A + B].

The need for blood transfusion postoperatively was decided by the Anaesthetist.

[A]= Some of blood drained in the suction unit

[B]= Blood from gauze

DATA COLLECTION

The data obtained was tabulated meaningfully in a Microsoft Excel sheet and subjected to statistical analysis. Data on blood loss, the duration of surgery, the mean arterial pressure, haemoglobin, haematocrit, and RBC levels were calculated and tabulated. The time taken for different the surgery and amount of blood loss of each case was recorded.

STATISTICAL ANALYSIS

Data analysis was carried out using SPSS Software version 19. Data related to Arterial pressure, Blood loss, and the duration of surgery was expressed in terms of descriptive statistics. Comparison between the means of Haemoglobin%, Haematocrit%, and Red Blood Cell% among study subjects before and after surgery was done using Paired t-test. For all the analysis p-value of < 0.05 was considered to be statistically significant.

Figure 1: Nitroglycerine diluted in DNS.

Figure 2: Pulseoximeter

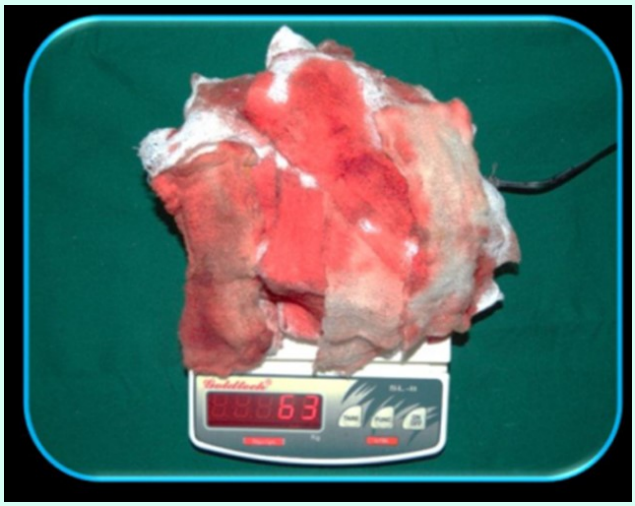


Figure 3: Weighing machine with blood soaked gauze.

Figure 4: Suction drain.

Results

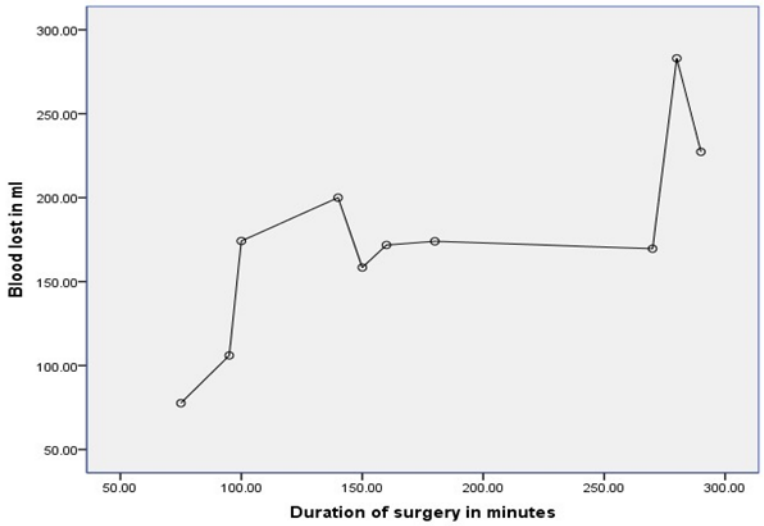
The Mean preoperative haemoglobin level was 12.14 gm% and the postoperative haemoglobin level was 10.06 gm%, the reduction in post-op value was 2.08 gm% (Table 2). The amount of blood loss, duration of surgery (Graph 1) and mean arterial pressure values (Graph 2) are enlisted in (Table 3 & 4).

Table 2: Comparison of Haemoglobin%, Haematocrit% and RBC% among study subjects before and after surgery.

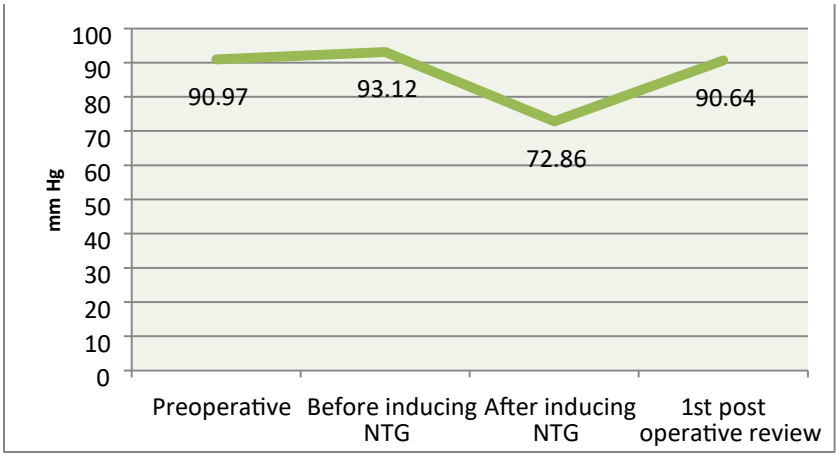
Variable	Time Period	N	Mean(SD)	Mean Difference	T Value	DF	P Value
Haemoglobin%	Preoperative	10	12.14 (1.68)	2.08	6.47	9	0.001*
	Postoperative	10	10.06 (1.75)				
Haematocrit%	Preoperative	10	40.50 (5.58)	7.30	6.72	9	
	Postoperative	10	33.20 (5.83)				
RBC %	Preoperative	10	36.42 (5.04)	6.24	6.47	9	
	Postoperative	10	30.18 (5.25)				

*HS – Statistically significant using Paired t test; SD - standard deviation

Graph 1: Scatter diagram showing the correlation between the amount of blood loss and duration of surgery in minutes.



Graph 2: Line diagram showing the mean arterial pressure of the study subjects recorded at various time period.



NTG - Nitroglycerine

Table 3: Blood loss and Duration of surgery among study subjects.

Variable	N	Range	Minimum	Maximum	Mean (Median)	SD. Deviation
Blood loss (ml)	**10**	205.40	77.60	283.00	174.19 (172.9)	57.33
Duration (minutes)	**10**	215.00	75.00	290.00	174 (155)	79.85

SD - standard deviation

ml – Milli liter

Table 4: Mean Arterial pressure of the study subjects recorded at various time period.

Time period	N	Range	Minimum (mm Hg)	Maximum (mm Hg)	Mean (mm Hg)	SD. Deviation (mm Hg)
Preoperative	10	10.00	83.30	93.30	90.97	3.53
Before inducing NTG	10	15.00	83.30	98.30	93.12	4.98
After inducing NTG	10	15.30	63.30	78.60	72.86	4.89
one day post operative	10	16.60	80.00	96.60	90.64	5.15

SD - standard deviation

Discussion

Orthognathic surgery basically involves planned and surgical fracturing of the facial bones and repositioning and fixing them into desired positions for correcting the dentofacial deformities [4]. Due to the abundance of vascularity of the maxillofacial region, these surgical procedures result in extensive blood loss that it may even require blood transfusion [5]. Blood transfusion on the other hand, is associated with a number of complications including transmission of blood borne pathogen and potential risk of transfusion reaction. With the use of induced hypotensive anaesthesia, intraoperative blood loss is reported to be considerably lesser and requirement for blood transfusion is significantly decreased. Hypotensive anaesthesia maintains a state of induced, controlled hypotension during anaesthesia and surgery to reduce bleeding and to improve the quality of the surgical site [6-9].

In the present observational study, the surgical procedures were done under induced hypotensive anesthesia, maintaining a mean arterial pressure of 72.86 mm Hg recorded using noninvasive blood pressure monitoring. A standard 15^0 elevation of head was practiced; patient was made to lay in a supine position on the operating table and the angle of the mandible was above the level of the heart. Operating time wasn't standardized due to variables like electro cautery setting, multiple surgeons, instrument handling during surgery, quality of surgical field and the length of the surgical procedure.

In a study by precious et. al., estimated that blood loss was significantly less when hypotensive anesthesia was induced. The surgical field was better, but there was no significant difference in duration of the procedure with induced hypotensive anaesthesia [10]. In the present study, blood loss was measured by volumetric and gravimetric techniques with strict attention directed to the amount of irrigants used. In the present study nitroglycerin was used as a hypotensive anaesthetic agent to maintain the mean arterial pressure during osteotomy at 72.86 mm Hg. The mean operating time for single jaw surgery was 112.6 minutes, and for double jaw surgeries was 236.6 minutes. The mean blood loss for single jaw procedure was 143.65 ml and double jaw surgery was 236.76 ml when done under hypotensive anaesthesia. The mean body weights of our patients were 54.1 kgs.

The pre and postoperative blood investigations included Haemoglobin and Haematocrit values. The Mean preoperative haemoglobin level was 12.14 gm% and the postoperative haemoglobin level was 10.06 gm%, the difference in the mean haemoglobin between the pre op and post op values was calculated and the reduction in post op value was 2.08 gm%.

The Mean preoperative haematocrit value was 40.50% and the mean postoperative hematocrit value was 33.20%. The difference in the mean Haematocrit levels pre and postoperatively was calculated and the reduction in post op value was 7.30%. No blood transfusion was required for any of the patients. The mean preoperative Red Blood Cell count was 36.42% and mean postoperative count was 30.18%. The difference in the mean Red Blood Cell count was calculated and the reduction in post op value was 6.24%.

Controlled hypotensive anaesthesia in our study ranges from 63 – 78 mmHg with mean of 72.86 mmHg which reduced the blood loss and provided a relatively clear working field. This has been reported by several studies [11,12]. None of the patients included in the present study required blood transfusion. These results goes in hand with several other authors who also reported blood transfusions were not needed for those surgeries done under hypotensive anaesthesia [13-15]. A systematic review and Meta-analysis by Susie Lin et. al, on 'Effects of Hypotensive Anaesthesia on Reducing Intraoperative Blood Loss, Duration of Operation, and Quality of Surgical Field During Orthognathic Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials' concluded that hypotensive Anaesthesia results in a sparing of about 169 mL of blood during orthognathic surgery in general and also showed to improve the quality of the surgical field in orthognathic surgery[16]. It also stated that hypotensive anaesthesia did not show a significant reduction of the operation time in orthognathic surgery. The confounding factors that need to be considered in the present study is that, although all subjects with known medical conditions and vascular conditions were excluded from our study, we have to appreciate each individual's vascular anatomy of the maxilla. The duration of the orthognathic surgery may be totally based on the level of difficulty of the surgery and skills of the surgeon.

Conclusion

Hypotensive anaesthesia provides an effective and relatively safe mean to reduce the amount of blood loss during the orthognathic surgery and reduce the need for blood transfusion and its side effects. However, the risk of insufficient infusion of vital organs and also renal and hepatic injuries in using hypotensive anesthesia must be addressed with care.

Conflict of Interest

The authors declare no conflict of interest.

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