Pak Heart J 2024:57(01)
ISSN:0048-2706 E-ISSN:2227-9199

# COMPARATIVE STUDY OF CRITICAL MOMENT HYPOTENSION VERSUS CONTROLLED HYPOTENSION ON INTRA-OPERATIVE BLOOD LOSS DURING BILATERAL SAGITTAL SPLIT OSTEOTOMY SURGERY: A RANDOMIZED CONTROLLED TRIAL

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## ABSTRACT

**Introduction**: Despite the fact that orthognathic surgery is generally regarded as safe, it does result in significant blood loss. Numerous pharmacological and non-pharmacological approaches have been utilised to address this issue. Controlled hypotensive anaesthesia administered throughout surgery and critical moment hypotension anaesthesia administered at a specific time, such as during the LeFort down fracture or the Sagittal Split, have both been used effectively to limit blood loss. There is currently no research that contrasts these two techniques to determine which is more applicable at minimising the loss of blood throughout the procedure of orthognathic surgery.; however, numerous authors have examined the use of both procedures. This study's objective is to compare the effects of general versus critical moment hypotension anaesthesia on the loss of blood throughout the procedure of orthognathic surgery.

**Materials and methods-** Eighteen adults with dentofacial deformities necessitating the orthognathic procedure Bilateral Sagittal Split Osteotomy were considered. They were split into three categories using a simple randomization strategy. Throughout the operation, Group I received a 10mg/kg body weight intravenous infusion of controlled hypotension anaesthesia. Group II received normotensive anaesthesia during surgery, while Group III received critical moment hypotension anaesthesia. Blood loss is estimated by calculating the total amount of blood suctioned, excluding saline solution and gauze saturated with blood. Also compared were haemoglobin and hematocrit levels before and after surgery.

**Results-**There were no statistical significant disparities between the sexes in hematocrit, surgical duration/time, bleeding/blood loss, or HB loss. Age was found to have a weak negative correlation (-0.19) with postoperative blood loss and hematocrit decrease (-0.30). There was no significant disparity among the interventions' total durations/time taken for surgery. There were statistically significant disparities in postoperative loss of blood, Hb loss, and haematocrit decrease between the groups. Loss of blood was found to correlate positively with hematocrit and Hb loss, whereas hematocrit loss was found to correlate positively with hematocrit loss. In the controlled hypotension group, mean blood loss was less than in the critical moment hypotension group.

**Conclusion-**Both critical moment hypotension anaesthesia and controlled hypotension anaesthesia are superior to full normotensive anaesthesia for minimising intraoperative blood loss. In addition, the effectiveness of critical moment hypotension anaesthesia was comparable to that of controlled hypotension anaesthesia. Therefore, it is possible to reduce the use of controlled hypotension anaesthesia in orthognathic surgeries

**Keywords**: Bilateral sagittal split surgery, Quality of life, hypotension anesthesia , Blood loss.

## Introduction

The BSSO spilt is generally used to treat mandibular malformations such as prognathism and retrognathism. After performing osteotomy, the distal segment of mandible is repositioned to correct misalignment and establish appropriate jaw function. Due to the osteotomy of cancellous bone and the risk of injuring the inferior alveolar artery, blood loss is a crucial aspect of BSSO surgery (1). Both mandibular prognathism and macrognathia, which are defining characteristics of Class III malocclusion (2), (3) in male Caucasians, have skeletal origins. Class III malocclusion prevalence among Caucasians ranges between 0.48% - 4% (4), (5). Class III malocclusion group are ideal participants for the study's surgical intervention. In order to sustain a clear surgical field, assure patient safety, to lower the need for blood transfusions, it is essential to effectively manage blood loss. Several solutions are available to resolve the issue. It is crucial to minimise blood loss during surgical procedures, and nonpharmacological approaches (6) for hypotensive anaesthesia may aid in this regard. By redirecting blood away from the surgical site, blood loss is reduced in the Anti-Trendelenburg position, in which the patient's head is raised and their legs are positioned below their sternum. Acute normovolemic hemodilution (ANH) seeks to decrease hematocrit and blood viscosity just prior to surgery to increase flow of blood and decrease loss of blood. This is accomplished by substituting intravenous fluids or colloids for a portion of the patient's blood. Continuous Positive Airway Pressure (C P A P) & Positive End Expiratory Pressure (P E E P) are examples for positive airway pressure treatments that help maintain open airways, increase oxygen saturation, strengthen the cardiovascular system, and reduce the risk of haemorrhage. Obtaining hypotensive anaesthesia significantly depends on pharmacological techniques (7). Using volatile anaesthetics such as sevoflurane or desflurane, blood pressure can be lowered in a controlled manner. The intravenous anaesthetic propofol's sedative and hypotensive effects are adjusted via titration. Opioids, such as fentanyl and remifentanil, alleviate pain and may also reduce blood pressure. By relaxing smooth muscle in the blood arteries, intravenously administered nitrates such as nitroglycerin can lower blood pressure. Inhibiting the activation of beta adrenergic receptors by adrenaline, beta adrenergic antagonists such as esmolol and labetalol reduce blood pressure by slowing the heart. Vasodilation and decreased blood pressure are two advantages of calcium channel blockers (CCB) such as verapamil & diltiazem. Intravenous alpha 2 adrenergic agonist like Dexmedetomidine & Clonidine result in sedation, analgesia, and hypotension. In order to induce therapeutic hypotension, esmolol is frequently administered intravenously. When administered intravenously, nitroglycerin relaxes the smooth muscle of blood vessels, resulting in a decrease in blood pressure.

In addition to hypotensive anaesthesia , tranexamic acid, Desmopressin, prostacyclin, dipyridamole ,-aminocaproic acid (EACA) recombinantfactorVIIa, aprotinin, and erythropoietin are used to limit the loss of blood during surgical procedures. In addition to reducing the risk of haemorrhage complications, these medications have additional benefits. Controlled hypotensive anaesthesia, which is administered continuously throughout the operation, and critical moment hypotension anaesthesia, which is administered only at crucial moments such as the LeFort down fracture and the Sagittal Split, have been utilised in surgical procedures. These anaesthetic procedures utilise drugs such as propofol, Dexmedetomidine, esmolol, and volatile anaesthetics in higher concentrations. Patients are also administered nitroglycerin to help lower their blood pressure. In conjunction with cautious blood pressure monitoring, the main focus of these medications is to mitigate blood loss during surgery. This objective aims to ensure a clear surgical field and enhance patient safety. By providing precise control over hemodynamic parameters throughout the procedure, these anesthetic techniques aim to optimize surgical results and minimize the potential risks associated with excessive bleeding. The utilization of ganglionic blocking medications for hypotensive-anesthesia in oral & maxillofacial surgery was initially described by Enderby.et.al. during their study (8). In 1976, Schaberg et al. (9) conducted the first investigation on loss of blood & the management of hypotension in orofacial-surgical correction, employing sodium nitroprusside. Further studies have documented the subsequent use of nitroglycerin, labetalol, isoflurane, and esmolol to induce hypotension during orthognathic surgery (10), (11). Initial research indicated that controlled hypotension caused no risk of impaired perfusion to the brain, heart, or kidneys; however, more recent research indicates otherwise. Consequently, the hypotensive technique may not be suitable for all individuals due to the potential safety risks that it may cause. In the context of orthognathic surgery, controlled hypotension has been the subject of extensive research, but there is still no consensus regarding its utility. Abhivyakti Tewari et al. (12) used controlled hypotension to decrease blood loss and enhance surgical field vision. Twenty individuals who underwent LeFort I osteotomy (13) received normotensive and hypotensive anaesthesia. In a number of respects, the hypotensive group substantially outperformed than normotensive group, including significantly less blood loss, better haemoglobin and hematocrit levels, and an improved surgical field. There were no significant changes in surgical duration or postoperative morbidity.In a study conducted by D.S. Precious (14), In adolescents undergoing orthognathic surgery, the impact of induced hypotensive anaesthesia on the loss of blood, surgical field quality, alongside procedure duration were investigated. Fifty individuals who had undergone orthognathic-surgery were included in the investigation. One group received standard anaesthesia, while the other received anaesthesia with induced hypertension. According to the findings, induced hypotensive anaesthesia improved the quality of the surgical field and decreased the estimated loss of blood. However, there was no significant disparity between both groups in terms of surgical duration. The researchers concluded that patients undertaking orthognathic-surgery with induced hypotensive anaesthesia had improved surgical field conditions and less loss of blood. In terms of minimizing the loss of blood during orthognathic surgery, there is no direct comparison between Critical Moment Hypotensive Anaesthesia and Controlled Hypotensive Anaesthesia at this time. The present research aims to compare the quantity of loss of blood during BSSO surgery under Critical Moment Hypotensive Anaesthesia and Controlled Hypotensive Anaesthesia.

## Materials & Methodology

**StudyDesign**

The InstitutionalScientificReview Council at SaveethaUniversity authorised the clinical research as a double-blind, Randomised Controlled Trial.

**Ethical Approval**

The Institutional Human Ethical Committee approved the clinical trial on ethical considerations.

**Sample size**

Sample size determined using G power as N=18 according to Vikram Shetty et al., (India, 2015) n=6 per group for 3 groups. With a power of 95%

**Study Groups**

1. **Group I** – controlled hypotension anesthesia (n=6)
2. **Group II** – critical moment hypotension anesthesia (n=6)
3. **Group III** – complete Normotension anesthesia (n=6)

**Eligibility criteria**

**Inclusion criteria:**

Normotensive adult patients requiring only Bilateral sagital split osteotomy orthognathic surgery who were ASA I (15) risk for surgery under General anesthesia (16),(17).

**Exclusion criteria:**

1. Individuals with cleft lip, cleft palate, and other facial cleft conditions
2. Individuals diagnosed with systemic illness
3. bleeding Disorders patients
4. Participants with known allergy to the test drugs
5. Pregnant or breastfeeding mothers
6. Participants who were under the medication of anticoagulants.
7. Participants who refused consent for this study

**Study setting**

Beginning at March 2022 to February 2023, the research project was carried out at the Dept. of Oral & Maxillofacial Surgery at Saveetha Maxfax Operation Theater within Chennai.

**Method of randomization**

Simple randomization was used in this study

**Allocation concealment**

The allocation order was concealed using the Sequentially Numbered, Opaque, Sealed Envelopes (S N O S E) method prior to the distribution of interventions. An independent third party, not involved in the study, prepared the envelopes by placing a piece of paper with a random group number and a serial number inside a standard black envelope. As participants entered the study sequentially, they were assigned their study number. The envelope containing the assigned intervention was opened after the assignment was made, and the treatment was subsequently administered based on the group indicated on the paper, as further detailed later.

**Blinding**

The patient remained unaware of the specific anesthesia used in their surgery, while the surgeon and anesthetist were informed of the administered drugs. The assessor in the study, responsible for evaluating blood loss, hemoglobin values, and preoperative/postoperative hematocrit values, was also blinded to the study group assignments.

**Surgical Procedure**

The procedures carried out was bilateral sagittal split osteotomy, Preoperative assessment consisted of a completed blood examination inclusive of haemoglobin, haematocrit. based on groups Patients were given complete hypotensive anesthesia ,critical moment hypotensive anesthesia, complete normotensive anesthesia

In group I Controlled hypotensive anesthesia, with 2% sevoflurane , inj Nitroglycerine IV was started as continuous infusion starting at 10 mcg/min and titrated slowly till target MAP of 60-70 mm Hg was achieved and maintained the same throughout the surgery.

In group II Critical moment hypotensive anesthesia during critical moment at Sagital split bilaterally inj Nitroglycerine infusion started at dose of 10 mcg/min and titrated for a MAP of 60 to 70 mm Hg was achieved only during the osteotomy phase of surgery approximately period of 20min.

In group III Complete Normotensive anesthesia, with 2% sevoflurane anesthesia maintained to MAP 70 to 90 mm hg.

During the surgical procedure, vital signs were continuously monitored, and Loss of blood has been determined by subtracting the volume of saline used from the volume of fluid gathered in the vacuum apparatus. Additionally, the weight difference between the soaked and pre-soaked dry gauze used throughout the procedure was taken into account. The decision to administer a blood transfusion was made by the anesthetist, with the threshold for hemoglobin set at 8g%. Following the surgery, post-operative measurements of hemoglobin and hematocrit were performed.

**Statistical Analysis**

The data was recorded using a Microsoft Excel spreadsheet, while version 20 of SPSS software was employed for the statistical analysis. Statistical descriptors were generated, and Using a single/one-way ANOVA (analysis of variance) and posthoc Bonferroni tests, the loss of blood among the groups was assessed. Using paired t- Tests the variations in haemoglobin and hematocrit over time were assessed among groups. The significance threshold for determining statistical significance was established at 0.05 or less.

**Results**

**Analyzing of Gender & age Distribution**

| **Gender** | | **Frequency** | **Percent** | **AGE (MEAN ± Std. Deviation)** |
|---|---|---|---|---|
| **Total (N= 18)** | Male | 10 | 55.6 | 27.3± 6.54 |
| | Female | 8 | 44.4 | |
| **Group 1 (N=6)** | Male | 2 | 33.3 | 22.8± 4.26 |
| | Female | 4 | 66.7 | |
| **Group 2 (N =6)** | Male | 4 | 66.7 | 30.8± 5.45 |
| | Female | 2 | 33.3 | |
| **Group 3 (N= 6)** | Male | 4 | 66.7 | 28.3± 7.58 |
| | Female | 2 | 33.3 | |

**Table 1-** The table displays the gender distribution in three groups and the mean age for each group. Overall, out of 18 people, 10 were males (55.6%) and 8 were females (44.4%). Each group had a different gender distribution and mean age. Group 1 had a mean age of 22.8 ± 4.26, Group 2 had a mean age of 30.8 ± 5.45, and Group 3 had a mean age of 28.3 ± 7.58.

**Kendall Tau _b Correlation Analysis of Gender with Duration, Blood Loss, Hb Loss, and Haematocrit Loss after Loss**

| **Gender** | **Duration of surgery** | **Blood loss** | **HB loss after surgery** | **Haematocrit loss after surgery** |
|---|---|---|---|---|
| **Correlation** | -0.163 | -0.256 | -0.121 | -0.294 |

| | | | | |
|---|---|---|---|---|
| **Coeffecient** | | | | |
| **Sig. (2- tailed)** | 0.424 | 0.213 | 0.561 | 0.154 |
| **N** | 18 | 18 | 18 | 18 |

**Table 2:** Table shows Kendall Tau-b correlations and significance levels for gender and surgical factors. Weak negative correlation found with hematocrit loss after surgery (-0.294, p = 0.154). No significant correlations observed for duration, blood loss, or HB loss after surgery (coefficients -0.163 to -0.256, p = 0.213 to 0.561). No significant gender differences in these surgical factors.

**Pearson Correlation Analysis of Age with Duration, Blood Loss, Hb Loss, and Haematocrit Loss after Loss**

| **Age** | **Duration of surgery** | **Blood loss** | **HB loss after surgery** | **Haematocrit loss after surgery** |
|---|---|---|---|---|
| **PearsonCorrelation** | -0.310 | 0.188 | -0.19 | -0.30 |
| **Sig. (2- tailed)** | 0.210 | 0.455 | 0.450 | 0.905 |
| **N** | 18 | 18 | 18 | 18 |

**Table 3:** The table presents the Pearson correlation coefficients and significance levels examining the association between age and different surgical factors. The results indicate a weak negative correlation between age and both blood loss and hematocrit loss following surgery. However, no significant correlation/association exist within age &the duration of surgery or hemoglobin loss after surgery. Hence, there is no statistically significant relationship between age and these specific surgical factors.

**Comparing Surgery Durations: One-Way ANOVA Study on Inter-Group and Intra-Group Variations**

| **Duration of surgeryANOVA** | **Sumof square** | **df** | **MeanSquare** | **F** | **Sig.** |
|---|---|---|---|---|---|
| **BetweenGroup** | 221.5 | 2 | 110.7 | 0.241 | 0.789 |
| **WithinGroup** | 6884.4 | 15 | 458.9 | | |

**Table 4:** The table displays the results of an ANOVA analysis of surgery durations across groups. There was not a statistically significant distinction within the groups, indicating similar surgery durations within and between the groups studied.

**Exploring Surgery Durations: Tukey's Post Hoc Analysis on Inter-Group and Multiple Comparisons Variations**

| **DURATION OF SURGERY TUKEY POST HOC** | **COMPARINGG ROUP** | **MEAN DIFFERENCE** | **Std.Error** | **Sig.** |
|---|---|---|---|---|
| **GROUP1** | GROUP2 | 7.71 | 12.36 | 0.808 |
| | GROUP 3 | 0.58 | 12.36 | 0.999 |

| | | | | |
|---|---|---|---|---|
| **GROUP 2** | GROUP 1 | -7.71 | 12.36 | 0.809 |
| | GROUP 3 | -7.13 | 12.36 | 0.834 |
| **GROUP 3** | GROUP 1 | -0.58 | 12.36 | 0.999 |
| | GROUP 2 | 7.13 | 12.36 | 0.834 |

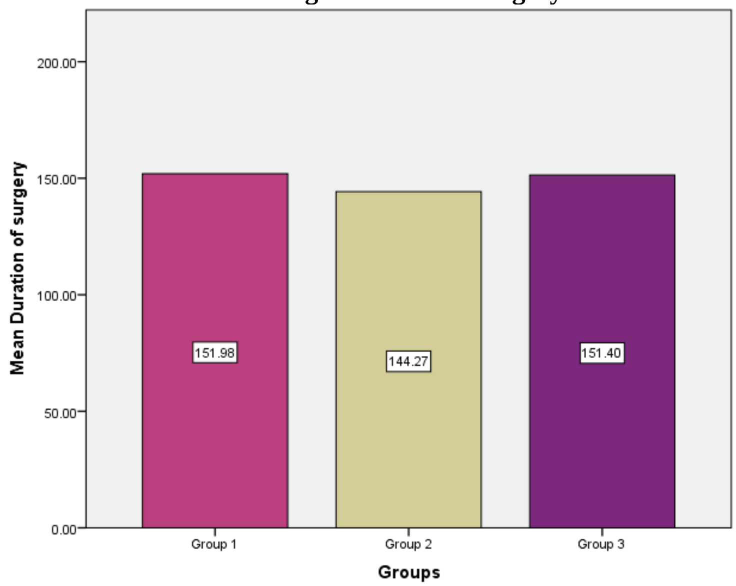
**Table 5:** The presented table displays the outcomes of a Tukey post hoc analysis conducted to compare the durations of surgeries among different groups. The analysis revealed no statistically significant differences in surgery durations between Group1 & Group2, Group1 & Group3, or Group2 & Group3. Hence, the durations of surgeries were found to be similar across all groups.

**Kendall Tau _b Correlation Analysis of Duration of surgery with Gender , Blood Loss/Loss of blood, HbLoss, and Haematocrit Loss after Loss**

| **Duration of surgery** | **Gender** | **BloodLoss/Lossof blood** | **HBloss after surgery** | **Haematocrit loss after surgery** |
|---|---|---|---|---|
| **Pearson Correlation (N = 18)** | -0.163 | 0.251 | 0.121 | 0.213 |
| **Sig.(2-tailed)** | 0.424 | 0.149 | 0.492 | 0.224 |
| **Kendrall'sCorrelation coefficient (N = 18)** | -0.163 | 0.251 | 0.121 | 0.213 |
| **Sig. (2- tailed)** | 0.424 | 0.149 | 0.492 | 0.224 |

**Table 6:** The provided table exhibits the results of Kendall's Tau-b and Pearson correlation analyses conducted to evaluate the correlation/relationship between surgical duration and various variables. The findings indicate weak correlations between the duration of surgery and factors such as gender, blood loss, Hb loss, and hematocrit loss. However, none of these correlations reached statistical significance, indicating that there is no significant relationship observed in the sample.

**Mean/average duration of Surgery**




**Graph 1:**The graph depicts the mean/average duration of surgery across 3 different groups. Group 1 had a mean surgery duration of 151.98 min, Group 2 had a mean duration of 144.27 min, and Group 3 had a mean duration of 151.40 min.

**Comparing Blood loss : One-Way ANOVA Study on Inter-Group and Intra-Group Variations**

| **Blood loss ANOVA** | **Sum of square** | **df** | **MeanSquare** | **F** | **Sig.** |
|---|---|---|---|---|---|
| **BetweenGroup** | 221.5 | 2 | 110.7 | 11.38 | 0.01 |
| **WithinGroup** | 6884.4 | 15 | 458.9 | | |

**Table 7:** The provided table displays the results of the ANOVA analysis conducted to examine blood loss among the groups. The analysis revealed a significant between-group variation, with a sum of squares of 221.5. The calculated F-value was 11.38, and the associated p -value was 0.01, indicating a significant statistical difference in blood loss/ loss of blood between the groups.

**Exploring Blood LOSS : Tukey's Post Hoc Analysis on Inter-Group and Multiple Comparisons Variations**

| **BLOOD LOSS TUKEY POST HOC** | **COMPARING GROUP** | **MeanDifference** | **Std. Error** | **Sig.** |
|---|---|---|---|---|
| **GROUP 1** | GROUP 2 | -34.00 | 34.06 | 0.589 |
| | GROUP 3 | -154.66 | 34.06 | 0.001 |
| **GROUP 2** | GROUP 1 | 34.0 | 34.06 | 0.589 |

| | | | | |
|---|---|---|---|---|
| | GROUP 3 | -120.66 | 34.06 | 0.008 |
| **GROUP 3** | GROUP 1 | 154.66 | 34.06 | 0.001 |
| | GROUP 2 | 120.66 | 34.06 | 0.008 |

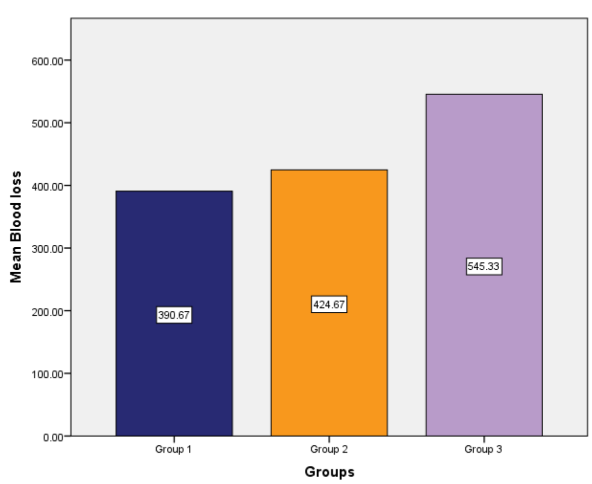
**Table 8:** The provided table displays the outcomes of Tukey's post hoc analysis conducted to assess blood loss across the groups. The results indicate no significant statistical difference in blood loss/loss of blood between Group1 & 2. However, significant statistical difference in blood loss/loss of blood were observed between Group1 & 3, as well as between Group 2 & 3.

**Pearson and Kendall's tau-b correlation analyses were conducted to examine the relationships between Blood Loss with Gender, Age , Hb Loss, and Haematocrit Loss after Loss**

| **BLOOD LOSS** | **Duration of surgery** | **HB loss after surgery** | **Haematocrit loss after surgery** | **Age** | **Gender** |
|---|---|---|---|---|---|
| **Pearson Correlation (N = 18)** | 0.269 | 0.537 | 0.793 | 0.188 | |
| **Sig. (2- tailed)** | 0.281 | 0.22 | 0.00 | 0.455 | |
| **Kendrall'sCorrelation coefficient (N = 18)** | 0.251 | 0.320 | 0.530 | - | -0.256 |
| **Sig. (2- tailed)** | 0.149 | 0.072 | 0.003 | - | 0.213 |

**Table 9:** The presented table displays the correlation coefficients assessing the relationship between blood loss and other variables. According to the Kendall's Tau-b analysis, there were no statistically significant correlations observed with gender or duration of surgery. However, there was a potential correlation with Hb loss (p-value =0.072) & a significant positive correlation with haematocrit loss (p=0.003). Similarly, the Pearson analysis revealed no significant correlations with duration of surgery or age. However, there was a positive correlation with Hb loss (p =0.22) and a strong correlation/relationship with haematocrit loss (p =0.00). It is essential to observe that there were 18 data points in the sample.

**Mean/average blood loss between groups**



**Graph 2:** The graph visually represents the average blood loss in three distinct groups. Group 1 had mean blood loss 390 ml, Group 2 had mean blood loss of 424.67 ml, and Group 3 had a mean blood loss/loss of blood of 545.33ml.

**Comparing Hb loss after surgery : One-Way ANOVA Study on Inter-Group and Intra-Group Variations**

| Hb loss after surgery ANOVA | Sumofsquare | df | MeanSquare | F | Sig. |
|---|---|---|---|---|---|
| **BetweenGroup** | 2.17 | 2 | 1.087 | 4.806 | 0.024 |
| **WithinGroup** | 3.39 | 15 | 0.226 | | |

**Table 10:** The table presents the results of the ANOVA analysis, indicating significant between-group variation in Hb loss after surgery (p = 0.024). The calculated F-value was 4.806, indicating a significant difference among the groups.

**Exploring Hb LOSS AFTER SURGERY : Tukey's Post Hoc Analysis on Inter-Group and Multiple Comparisons Variations**

| HB LOSS AFTER SURGERY TUKEY POST HOC | COMPARING GROUP | MEAN DIFFERENCE | Std. Error | Sig. |
|---|---|---|---|---|
| **GROUP1** | GROUP2 | 0.266 | 0.274 | 0.605 |
| | GROUP3 | -0.566 | 0.274 | 0.131 |
| **GROUP2** | GROUP1 | -0.266 | 0.274 | 0.605 |
| | GROUP3 | -0.833 | 0.274 | 0.021 |
| **GROUP 3** | GROUP 1 | 0.566 | 0.274 | 0.131 |
| | GROUP 2 | 0.833 | 0.274 | 0.021 |

**Table 11:** The provided table displays the outcomes of Tukey's post hoc analysis, which investigated the variations in Hb loss after surgery among the groups. The results reveal a significant disparity between Group 2 & 3 in terms of Hb loss. However, no significant disparity were observed between Group1 & Group2, or between Group1& Group3, regarding Hb loss.

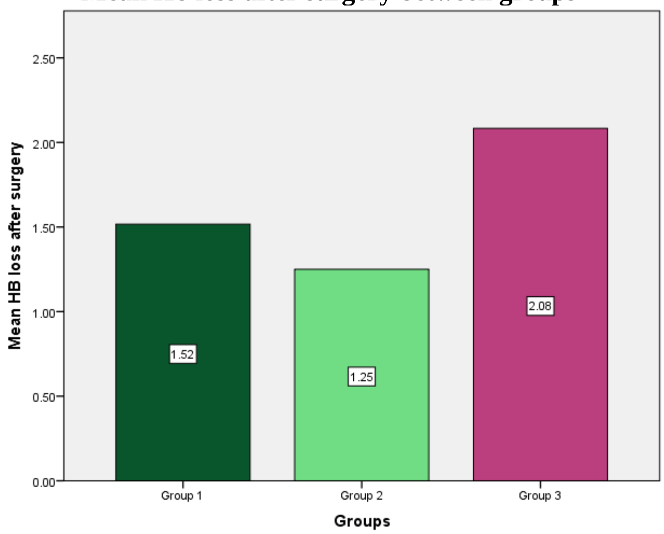
**Pearson and Kendall's tau-b correlation analyses were conducted to examine the relationships between Hb loss after surgery with Gender , Loss of blood/BloodLoss, Hb Loss, and Duration of surgery**

| HB LOSS AFTER SURGERY | Duration of surgery | Loss of blood/ Bloodloss after surgery | Haematocritloss after surgery | Age | Gender |
|---|---|---|---|---|---|
| **Pearson Correlation (N = 18)** | 0.150 | 0.537 | 0.643 | -0.190 | |

| | | | | | |
|---|---|---|---|---|---|
| **Sig. (2-tailed)** | 0.208 | 0.022 | 0.004 | 0.450 | |
| **Kendrall's Correlation coefficient (N = 18)** | 0.121 | 0.320 | 0.616 | - | -0.121 |
| **Sig. (2- tailed)** | 0.492 | 0.072 | 0.001 | - | 0.561 |

**Table 12:** Table presents the results of Kendall Tau-b correlation analysis examining the relationships between Hb loss after surgery and various variables. There were no significant correlations between Hb loss and gender or duration of surgery. However, there was a potential relationship between Hb loss and blood loss, and a significant positive relationship between Hb loss and haematocrit loss after surgery. The sample size was consistent with 18 data points available for analysis.

**Mean Hb loss after surgery between groups**




**Graph 3:** The graph illustrates the mean Hb loss after surgery in three groups. The mean duration of mean Hb loss after surgery in Group 1 was 1.52 gm/dl, while in Group 2 it was 1.25 gm/dl, and in Group 3 it was 2.08 gm/dl.

**Comparing Haematocrit loss after surgery : One-Way ANOVA Study on Inter-Group and Intra-Group Variations**

| **Haematocrit loss after surgery ANOVA** | **Sum of squares** | **df** | **MeanSquare** | **F** | **Sig.** |
|---|---|---|---|---|---|
| **BetweenGroup** | 8.890 | 2 | 4.445 | 4.067 | 0.039 |
| **WithinGroup** | 16.395 | 15 | 1.093 | | |

**Table 13** presents results of One Way ANOVA Analysis, which showed significant difference in haematocrit loss after surgery among the groups. The variability between the groups was larger than within the groups, indicating that the group factor has a significant impact on haematocrit loss after surgery.

**Exploring haematocrit loss after surgery : Tukey's Post Hoc Analysis on Inter-Group and Multiple Comparisons Variations**

| HAEMATOCRIT LOSS AFTER SURGERY TUKEY POST HOC | COMPARING GROUP | MEAN DIFFERENCE | Std. Error | Sig. |
|---|---|---|---|---|
| **GROUP1** | GROUP2 | 0.4 | 0.603 | 0.788 |
| | GROUP3 | -1.25 | 0.603 | 0.130 |
| **GROUP2** | GROUP1 | -0.4 | 0.603 | 0.788 |
| | GROUP3 | -1.65 | 0.603 | 0.039 |
| **GROUP 3** | GROUP1 | 1.25 | 0.603 | 0.130 |
| | GROUP 2 | 1.65 | 0.603 | 0.039 |

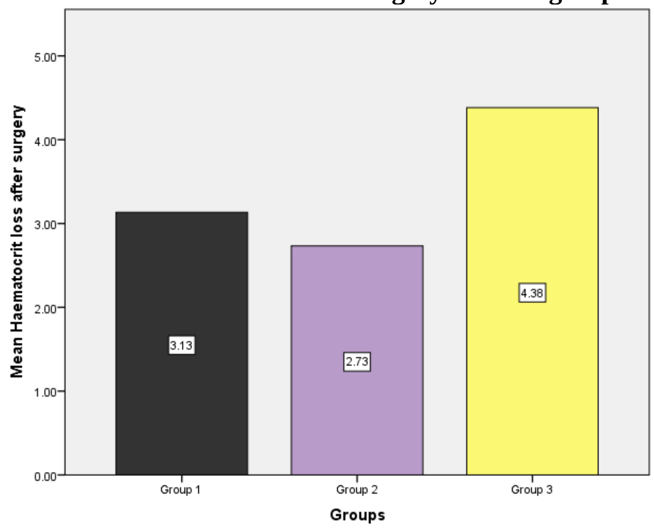
**Table 14** presents the results of Tukey's post hoc analysis, which compared haematocrit loss after surgery between different groups. The analysis revealed significant difference between Group2 & Group3, but no significant differences between Group1 & Group2, as well as between Group1 & Group3.

**Pearson and Kendall's tau-b correlation analyses were conducted to examine the relationships between haematocrit loss after surgery and variables such as blood loss after surgery, age, Hb loss, and haematocrit loss after loss.**

| HAEMATOCRIT LOSS AFTER SURGERY | Duration of surgery | Blood loss after surgery | HB loss after surgery | Age | Gender |
|---|---|---|---|---|---|
| **Pearson Correlation (N = 18)** | 0.311 | 0.793 | 0.643 | -0.03 | - |
| **Sig. (2-tailed)** | 0.208 | 0.00 | 0.004 | 0.905 | - |
| **Kendrall’sCorrelation coefficient (N = 18)** | 0.213 | 0.530 | 0.616 | - | -.294 |
| **Sig. (2- tailed)** | 0.224 | 0.003 | 0.001 | - | 0.154 |

**Table 15:** The table displays the results of Pearson and Kendall's tau-b correlation analyses for haematocrit loss after surgery. There was no significant statistical correlation observed among the duration of surgery. However, significant positive correlations were found between blood loss and Hb loss. Gender had a non-significant negative correlation. In summary, haematocrit loss is significantly associated with blood loss and Hb loss, but not with gender or duration of surgery.

**Mean Haematocrit loss after surgery between groups**




**Graph 3:**The graph visually depicts the average Haematocrit loss after surgery in three different groups. In Group 1, the mean Haematocrit loss after surgery was 3.13%. In Group 2, the mean Haematocrit loss after surgery was 2.73%. Finally, in Group 3, the mean Haematocrit loss after surgery was 4.38%.

## DISCUSSION

A comparative analysis examined critical moment hypotension versus controlled hypotension during bilateral sagittal split osteotomy surgery. No significant correlations were found between gender and hematocrit loss, duration of surgery, blood loss, or HB loss after surgery. The mean age was 27.3±6.54, and weak negative correlations were observed between age and blood loss (-0.19) and hematocrit loss (-0.30) after surgery. One-way ANOVA revealed no significant differences in surgery durations, and Tukey's post hoc analysis supported similar durations across groups. Both the Kendall Tau-b and Pearson correlation analyses failed to identify a significant relationship/Correlation within the surgery duration and the variables under consideration. Using one/single-way ANOVA &Tukey's posthoc examination, significant disparities in the loss of blood among the groups were identified, with Group 3 experiencing the highest blood loss. Additionally, significant disparities were observed between Groups 2 and 3 in postoperative Hb loss. Similarly, there were statistically significant disparities in postoperative haematocrit reduction among Groups 2& 3. A Pearson correlation analysis demonstrated a positive correlation between blood loss and haematocrit loss, as well as between Hb loss and haematocrit loss. However, no correlations were found between Hbloss along with the surgical duration or the patient's age. Likewise, there were no significant associations between haematocrit reduction and either surgical duration or age. The average amount of blood lost in Groups 1, 2, and 3 was 390 ml, 424.67 ml, and 545.33 ml, respectively. In Group 1, the average Hb loss was 1.52 gm/dl, in Group 2 it was 1.25 gm/dl, and in Group 3 it was 2.08 gm/dl. After surgery, Group 1 exhibited a mean decrease in haematocrit of 3.13 percent, Group 2 of 2.73 percent, and Group 3 of 4.38 percent.

The effectiveness of hypotensive-anaesthesia in minimising the loss of blood during orthognathic surgery was examined in a study by Chan.et al. (18). Controlled hypotensive anaesthesia demonstrated a safe 30% decline in mean arterial pressure, with few fatalities. The benefits included shorter recovery time, improved surgical area visibility, reduced blood waste, fewer transfusions, and faster and more precise procedures. Hypotensive anaesthesia was generally well tolerated by young and healthy individuals but not by those with severe cardiac or respiratory disorders. Acc. to a Systematic Review by Lin et al. (19), hypotensive anesthesia effectively minimizes loss of blood and enhances surgical field quality without shortening the duration of the operation. Combining local anesthesia with hypotensive anaesthesia further reduces blood loss. Another systematic review conducted by Aguilar et al. (20) revealed that most cases of orthognathic surgery had blood loss within acceptable limits for blood transfusion. However, there were instances of heavier bleeding, emphasizing the importance of surgeons being prepared with blood reserves or considering autotransfusion methods. Surgeons need to be aware of the potential for increased bleeding during these procedures. In a retrospective study by Samman et al. (21) involving 360 OGS patients, blood loss & transfusion requirements were assessed. The study found a wide range of estimated blood loss (50 to 5,000 mL), with 24% of cases requiring transfusion. Bimaxillary osteotomies had a higher frequency of transfusion, but it was not predictable based on the procedure type. In contrast, a prospective investigation by Yu et.al. (22) focussed on orthognathic surgeries performed under induced hypotension anesthesia. The preponderance of patients studied underwent double-jaw surgery. The estimated mean loss of blood was about 617.6mL, varying based on the type of osteotomy performed. However, the study had limitations, including a small sample size and the inability to blind surgeons to the anesthetic technique, hindering the assessment of surgical field quality. The findings provide evidence supporting the use of critical moment hypotensive anesthesia over complete or controlled hypotension. Future research could incorporate mean blood pressure measurements for improved correlation analysis.

## CONCLUSION

Compared to normotensive anaesthesia, controlled hypotensive anaesthesia and critical moment hypotensive-anaesthesia have been shown to substantially reduce intra op blood loss during OGS Surgeries. In order to minimise dangers associated with controlled hypotensive-anaesthesia, orthognathic surgery can routinely employ critical moment hypotensive-anaesthesia during the necessary period.

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