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Original Research Article

Evaluation of blood loss and need for transfusion during orthognathic surgery in the era of limited blood transfusion

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Abstract: ***Background AND AIM***: The aim of this observational study was to evaluate blood loss during orthognathic surgery and to correlate clinical variables with the blood loss and transfusion needs in patients who undergo orthognathic surgery. ***MATERIALS AND METHODS:*** The study consisted of forty- two patients. Intraoperative blood loss and operating time was noted. Pre-operative and post-operative blood ingredients like haemoglobin, haematocrit and RBC counts were also noted. The surgery was categorised as maxillary procedures, mandibular procedures and bimaxillary procedures. ***RESULTS:*** In the total population, the mean operative time was 165.36 ± 69.9 minutes while the mean blood loss in the patients was 437.27± 414.6 mL. There was a significant mean reduction in blood parameters like haemoglobin, haematocrit and RBC($p<0.001$). There was positive correlation between blood loss and operating time. ***CONCLUSION:*** Within the limitations of the study, it was concluded that even though there is a significant reduction of blood ingredients in patients undergoing orthognathic surgery, only 14% of patients underwent allogenic blood transfusion.

Keywords: Allogenic blood transfusion; Blood loss; Operating time; Orthognathic surgery,Lefort 1 osteotomy,Anterior maxillary osteotomy,Bilateral Sagital Split osteotomy

INTRODUCTION

Orthognathic surgery can be defined as the art and science of diagnosis and treatment by combining orthodontics and oral surgery to correct dentosseous, musculoskeletal and soft tissue deformities of jaws [1]. Since there is rich blood supply to head and neck

region, considerable bleeding should be anticipated both from incised soft tissue and bone during orthognathic surgery. The use of hypotensive anaesthesia has reduced the transfusion rate dramatically and in contrast to earlier recommendations haemoglobin values between 7 g/dL and 8 g/dL seem to be acceptable in healthy patients [2]. Intravenous and topical tranexamic acid has been reported to reduce blood loss during surgery [3]. Despite rigorous testing of every unit of blood risk of transmission of several pathogens still remains [4]. Postoperative infection is another complication of allogenic transfusion. A haemoglobin concentration of 6.5–7.0 g/dL was regarded as the threshold for transfusion. Blood loss in bimaxillary orthognathic operations is usually between 400 and 600 mL, transfusion should not be considered in a healthy patient.More accurate estimation of the predicted surgical duration and blood loss volume could enable surgeons and anaesthetists to improve management during the operation. This study is hence aimed to correlate clinical variable with blood loss and need of transfusion during orthognathic surgical procedures. It also evaluates the average blood loss during maxillary and mandibular procedures when done alone or in combination.

METHODOLODY

Study Design

This observational study was carried out from June 2017 to August 2018. Inclusion criteria were patients with maxillary and mandibular defects, either alone or combined; healthy adults both males and females with age greater than or equal to 18; ASA class 1 and 2. Exclusion criteria were patients under anticoagulant therapy; patients with haematological disorders; patients with connective tissue disorders; patients with chronic systemic diseases.

Surgical Procedures

Surgical procedures were categorised as maxillary, mandibular or combined. Maxillary procedures included Le Fort 1, anterior maxillary osteotomy and mandibular procedures were bilateral sagittal split osteotomy, genioplasty and subapical osteotomy. All surgeries were performed by a single surgeon with the same anaesthesia protocols.General anaesthesia was induced with propofol 2-3 mg/kg and scoline 100mg as a relaxant. Hypotensive anaesthesia was maintained with nitro-glycerine 3-10 µg/kg/minute and was titrated to maintain a mean arterial blood pressure of 60-65mmHg during the surgery.

Assessment

Operating time was calculated from the time of mucosal incision to the closure. Haematological data such as haemoglobin level, RBC, packed cell volume were recorded one day before the surgery and on the 1st postoperative day. Intraoperative blood loss was quantified by measuring the amount of blood in the suction device, weighing blood soaked gauze and subtracting saline used. An electronic kitchen scale was used for weighing the gauze.

Blood transfusion criteria

Allowable blood loss was calculated from the above formulae. Allowable blood loss =
Estimated blood volume x (preop Hb – Lowest allowable Hb) Average of preoperative and lowest acceptable Hb

We consider the lowest acceptable Hb as 8 grams/decilitre. Blood loss up to allowable blood loss was replaced with a crystalloid solution and above allowable blood loss; it was replaced with whole blood. It was the anaesthetist who decided the need for blood transfusion intraoperatively.

Statistical Analysis

Data were coded and entered in MS Excel and analysis was done using SPSS trial version 22. Changes in blood constituents due to surgery was calculated analysed by paired t-test.Pearson's correlation coefficient will be used to detect correlations between blood loss and various parameters.

RESULTS

The mean age of the study population was 22.02±3.9 years, with a gender distribution of females higher than males with 26 female patients (61.9%) and 16 male patients (38.1%).The most common procedure done was the bimaxillary procedure in 24 patients (57.1%), followed by the mandibular procedure in 15 patients (35.7%) and maxillary procedure in 3 patients (7.1%).The mean operative time in the total population was 165.36 ± 69.9 minutes. The mean blood loss in the patients was 437.27± 414.6 mL. The mean operative time and mean blood loss was higher in bimaxillary procedure group 185.2 ± 77.9 minutes and 583± 491.7 mL (Table 1) . The correlation between blood loss and operating time showed a positive correlation, which means as the operating time increased there was a significant amount of increase in blood loss (Table 3). Also, there existed a negative correlation between blood loss and RBC count which means, blood loss resulted in reduction of RBCs, and this change .was statistically significant. In the surgical category, only bimaxillary procedures showed a significant statistical correlation. Among females, haemoglobin and haematocrit levels showed statistically significant correlation with blood loss. RBC levels showed statistically significant positive correlation with blood loss among males. Six out of forty-two (14.3 %) patients required allogenic blood transfusion in this study. One patient underwent pre-operative blood transfusion and 5

patients underwent a blood transfusion post-operatively. Five patients who required blood transfusion underwent bimaxillary surgery. Blood transfusion was also required in a female patient who underwent anterior maxillary osteotomy.

Table 1: Study variables tested	Mean	±	Standard Deviation
Operative time (range: 45 t0 315))	165.36	±	69.9
Blood loss (ml) (range:50-1934)	437.27	±	414.6
Pre-surgical blood ingredients	**Mean**	**±**	**Standard Deviation**
Haemoglobin (g/dL)	13.5	±	1.7
Haematocrit (%)	39.6	±	4.3
Red blood cells ($x10^6/\mu L$)	4.7	±	0.5
Post-surgical blood ingredients	**Mean**	**±**	**Standard Deviation**
Haemoglobin (g/dL)	11.0	±	1.7
Haematocrit (%)	31.7	±	4.4
Red blood cells ($x10^6/\mu L$)	3.8	±	0.5

Table 2:Reduction in blood parameters				
Total patients	Mean Reduction	Standard Deviation		P value
Haemoglobin (g/dL)	2.5		1.2	
Haematocrit (%)	7.8	3.7		<0.001
Red blood cells ($x10^6/\mu L$)	0.89		0.5	
Bimaxillary procedures	Mean Reduction	Standard Deviation		P value
Haemoglobin (g/dL)	2.7		1.16	
Haematocrit (%)	8.4	3.4		< 0.001
Red blood cells ($x10^6/\mu L$)	1.0		0.5	
Mandibular procedures	Mean Reduction	Standard Deviation		P value
Haemoglobin (g/dL)	1.9		0.9	
Haematocrit (%)	6.5	3.2		<0.001
Redbloodcells			0.3	

($x10^6$/μL)	0.7		
Maxillary procedures	Mean Reduction	Standard Deviation	P value
Haemoglobin (g/dL)	3.7	1.9	
Haematocrit (%)	11.2	6.2	<0.001
Red blood cells ($x10^6$/μL)	1.1	0.8	

Table 3 :Correlation between Blood loss and Reduced blood parameters

Total patients		Correlation coefficient	p value
	Operating time	0.319	0.040
	Haemoglobin (g/dL)	0.477	0.001
	Haematocrit (%)	0.426	0.005
Red blood cells ($x10^6$/μL)		0.475	0.001
Bimaxillary procedures		Correlation coefficient	p value
	Operating time	0.241	0.257
	Haemoglobin (g/dL)	0.509	0.011
	Haematocrit (%)	0.46	0.024
Red blood cells ($x10^6$/μL)		0.435	0.033
Mandibular procedures		Correlation coefficient	p value
	Operating time	0.376	0.167
	Haemoglobin (g/dL)	0.087	0.759
	Haematocrit (%)	0.317	0.250
Red blood cells ($x10^6$/μL)		0.143	0.612
Maxillary procedures		Correlation coefficient	p value
	Operating time	-0.996	0.056
	Haemoglobin (g/dL)	0.811	0.398
	Haematocrit (%)	0.722	0.486
Red blood cells ($x10^6$/μL)		0.641	0.557

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DISCUSSION

Orthognathic surgery involves surgical handling of the facial skeleton to correct various dentofacial anomalies. The most frequently performed procedure in maxilla is Lefort 1 osteotomy and in the mandible is bilateral sagittal split osteotomy [5].
Posnick [6] et al suggested that transfusion is definitely indicated if the haemoglobin level is at or below 7g/dl and rarely considered if the haemoglobin level is more than 10g/dl.

Intraoperative haemorrhage was estimated by a volumetric method and gravimetric method. It was difficult to quantify the amount of blood on drapes, gowns, instruments and throat pack. There was also a chance of swallowing a small amount of blood. In addition to irrigating fluids and blood, the suction bottle also contained constituents such as saliva and bone powder. However, these things were applied commonly to all the cases and bias of blood loss can thus be avoided.

The total study population showed a mean blood loss of 437.27± 414.6mL. Pineiro-Aguilar et al in their systematic review found out a mean blood loss of 436.11 mL in orthognathic study.[7]A mean blood loss of 400 mL was reported by Oslen et al in their bimaxillary osteotomies [8] and Keith M, in his retrospective study observed a mean blood loss of 481.8 mL [9]. In a study conducted by H.S.Chen et al, the mean blood loss was 105.9 ± 66.83 mL during bilateral ramus osteotomy.[10]

The mean blood loss was 617.7 ± 575.2 ml in males and 326.2 ± 223.1ml in females. Similar to our study there was significantly more blood loss among males than in females in studies conducted Olsen et al [8].
While comparing the surgical procedures blood loss was higher in the bimaxillary group (583 ± 491.7) in our study.

The mean operative time in this study was 165 ± 69.9 minutes. Considering the surgical procedures, it was more in the bimaxillary group with 185.2 ± 77.9 minutes. A mean surgical duration of 255.5 ± 42.56 minutes was observed in a study conducted by H.S Chen et al [10]. Michael S Jaskolka mentioned that the amount of blood loss differed significantly with respect to various orthognathic surgical procedures and duration of surgery and suggested these as predictors of short-term quality of life after orthognathic surgery [12]. He also observed that bimaxillary procedures required one-week longer recovery period when compared to single jaw procedure. Thastum et al [13] reported that operating time and treatment modality had a significant impact on relative blood loss.

The pre-surgical blood ingredients showed higher values in males compared to females in this study which was similar to results observed in a study by Olsen et al [8].The mean reduction in blood parameters like haemoglobin, haematocrit and RBC was found to be significant.The average reduction of haemoglobin, haematocrit and RBC were 2.5g/dl, 7.8 % and 0.89x106/µL respectively (Table 2).

H.S Chen et al reported a mean reduction in blood constituents as follows; haemoglobin reduction of 1.9g/dl, haematocrit reduction of 5.7% and RBC count reduction of 0.7 [10]. A mean drop of haemoglobin concentration of 25% and PCV drop of 26% was observed post-operatively W.B Kretschmer et al.[3] Kretschmer et al in another study mentioned a 3.4g/dl drop of haemoglobin and 25% drop in haematocrit value compared to pre-operative value.

This study showed a positive correlation of blood loss with operative time and with the reduction in haemoglobin as well as RBC levels. A study by Keith M [9] to correlate different orthognathic surgeries with operating time and blood loss suggested that operating time explains 25% of the variance in blood loss. Winfried Kretschmer et al in their study reported a significant positive correlation between operating time and a decrease in haemoglobin and haematocrit values [3]. Rumasak, Apipan and Kaewpradup in 2011 and Tseng et AL [14] also had a similar positive correlation between operating time and blood loss [15].

In the present study, major vessels responsible for severe bleeding were descending palatine in Le Fort 1 osteotomy and inferior alveolar artery while performing BSSO osteotomies.

Strategies taken to reduce bleeding for surgery in our institution were the use of hypotensive anaesthesia, infiltrating the site of interest using local anaesthesia containing vasoconstrictor, careful incisions, and subperiosteal dissection. Lin et al [16] in their systematic review and meta-analysis reported that hypotensive anaesthesia resulted in a sparing of about 169mL of blood while performing orthognathic surgeries and has shown to improve the quality of the surgical field. Several studies have mentioned the use of hypotensive anaesthesia to reduce blood loss in orthognathic surgery [17]. Numerous studies have demonstrated the effectiveness of tranexamic acid to reduce bleeding in orthognathic surgery [18].

Literature review observed that use of the

piezoelectric unit, erythropoietin plus iron supplements, Yunnen Baiyo capsules are effective in reducing blood loss during orthognathic surgery.[19]Bleeding can also be reduced by infiltrating the area with a vasoconstrictor such as epinephrine prior to incision. It is usually given in combination with a local anaesthetic. A decrease in blood flow will be apparent in 5 minutes after administration.

Arimoto et al conducted a study and found out that ultrasonography was effective compared to magnetic resonance imaging to determine the location of the internal maxillary artery prior to intraoral vertical ramus osteotomy [18].

Only six patients (14.3%) out of forty-two patients required allogenic blood transfusion according to anaesthetist's protocol in this study however, none of them had any adverse reactions and postoperative period was uneventful. Five patients who required blood transfusion underwent bimaxillary surgery. Blood transfusion was also required in a female patient who underwent anterior maxillary osteotomy. Patient's haemoglobin level dropped from 11.45 to 9.8g/dL following a 220ml blood loss during surgery. Pre-operative blood transfusion was given for one among the six patients. The patient had a pre-operative haemoglobin value of 8.8g/dl and was transfused with two units of allogenic blood pre-operatively as per anaesthetist's instruction.

Only 1.8% of patients received a blood transfusion in a study conducted by Posnick, Choi and Chavda [19]. Politis et al observed an incidence of 0.27% life-threatening haemorrhages in Lefort 1 surgery. Posnick et al in 2010 reported that 6% of patients received an allogenic blood transfusion during bimaxillary orthognathic surgeries. M.Garg et al recommended that no routine coagulation screen or group and save with antibody screen is required for ASA 1 patients for orthognathic surgery. A study by Choi et al observed that no transfusion was required for 82 patients undergoing bimaxillary surgery.

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CONCLUSION

Within the limitation of our study, it was concluded that even though there is a significant reduction of blood ingredients in patients undergoing orthognathic surgery, only 14% of patients underwent allogenic blood transfusion.The study also confirms a positive relationship between intraoperative blood loss and operating time.

REFERENCES

1. Raymond.J.Fonseca,Norman J.Betts.Patient selection for orthognathic surgery.Norman J.Betts.Timothy A Turvey.Oral and Maxillofacila surgery, orthognathic surgery.2nd edition. Philadelphia:W.B Saunders company;2000.3-7.
2. Vikram Karande, Neelam Andrade, Vaishali Pagare, Sejal Bhaskar, & Ritik Kashwani. (2025). Cephalometrics for Orthognathic Surgery: Insights from Literature Review. The Bioscan, 20(Supplement 2), 687–690. https://doi.org/10.63001/tbs.2025.v20.i02.S2.pp687-690
3. Kretschmer W, Köster U, Dietz K, Zoder W, Wangerin K: Factors for Intraoperative Blood Loss in Bimaxillary Osteotomies. J Oral Maxillofac Surg 2008;66:1399-1403. https://doi.org/10.1016/j.joms.2008.01.060
4. Fenner M, Kessler P, Holst S, Nkenke E, Neukam FW, Holst AI.: Blood transfusion in bimaxillary orthognathic operations: Need for testing of type and screen.Br J Oral Maxillofacl Surg 2009;47: 612– 615. https://doi.org/10.1016/j.bjoms.2009.01.023.
5. Perisanidis C, Mittlböck M, Dettke M, et al. Identifying risk factors for allogenic blood transfusion in oral and oropharyngeal cancer surgery with free flap reconstruction. J Oral Maxillofac Surg.2013;71(4):798-804.https://doi.org/10.1016/j.joms.2012.08.028
6. Jeffrey C. Posnick, Alexander Rabinovich,Daniel T. Richardson: Blood Replacement Practices for Complex Orthognathic Surgery: A Single Surgeon's Experience. J Oral Maxillofac Surg 2010;68:54-
7. 59. https://doi.org/10.1016/j.joms.2009.07.055
8. Piñeiro-aguilar A, Somoza-martín M, Gandara-rey JM, García-garcía A. Blood loss in orthognathic surgery: a systematic review. J Oral Maxillofac Surg. 2011;69(3):885-92. https://doi.org/10.1016/j.joms.2010.07.019
9. Olsen JJ, Ingerslev J, Thorn JJ, Pinholt EM, Gram JB, Sidelmann JJ. Can Preoperative Sex-Related Differences in Hemostatic Parameters Predict Bleeding in Orthognathic Surgery? J Oral Maxillofac Surg. 2016;74(8):1637-42. https://doi.org/10.1016/j.joms.2016.03.012
10. Keith Matthew Schneider.Correlation of Blood Loss and Operating Time During Orthognathic Surgery.AAOMS.2008:106.
11. H.-S. Chen et al. Intraoperative blood loss during an osteotomy of the bilateral vertical ramus. Journal of Dental Sciences (2014) 9, 249e252. http://dx.doi.org/10.1016/j.jds.2013.04.008
12. Pagotto LEC, De santana santos T, De vasconcellos SJA, Santos JS, Martins-filho PRS.

Piezoelectric versus conventional techniques for orthognathic surgery: Systematic review and meta- analysis. J Craniomaxillofac Surg. 2017;45(10):1607-1613.https://doi.org/10.1016/j.jcms.2017.06.011

13. Foran M, Strickland F, Perkins K, Smith JA. Excessive intraoperative bleeding with chronic energy drink consumption. J Oral Maxillofac Surg. 2012;70(6):1439-41. https://doi.org/10.1016/j.joms.2011.03.067
14. Thastum M, Andersen K, Rude K, Nørholt SE, Blomlöf J. Factors influencing intraoperative blood loss in orthognathic surgery. Int J Oral Maxillofac Surg. 2016;45(9):1070-3. https://doi.org/10.1016/j.ijom.2016.02.006
15. Rummasak D, Apipan B, Kaewpradup P. Factors that determine intraoperative blood loss in bimaxillary osteotomies and the need for preoperative blood preparation. J Oral Maxillofac Surg. 2011;69(11):e456-60. https://doi.org/10.1016/j.joms.2011.02.085
16. Tseng YC, Ting CC, Kao YH, Chen CM. Comparison of intraoperative blood loss between four different surgical procedures in the treatment of bimaxillary protrusion. Oral Surg Oral Med Oral Pathol Oral Radiol. 2017;123(1):44-50.https://doi.org/10.1016/j.oooo.2016.08.022
17. Lin S, Mckenna SJ, Yao CF, Chen YR, Chen C. Effects of Hypotensive Anesthesia 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. J Oral Maxillofac Surg.2017;75(1):73-86. https://doi.org/10.1016/j.joms.2016.07.012
18. Secher JJ, Sidelmann JJ, Ingerslev J, Thorn JJ, Pinholt EM. The Effect of Tranexamic Acid and Gender on Intraoperative Bleeding in Orthognathic Surgery—A Randomized Controlled Trial.J Oral Maxillofac Surg .2017:7.https://doi.org/10.1016/j.joms.2017.11.015
19. Arimoto S, Hasegawa T, Okamoto N, et al. Determining the location of the internal maxillary artery on ultrasonography and unenhanced magnetic resonance imaging before orthognathic surgery. Int J Oral Maxillofac Surg. 2015;44(8):977-83.https://doi.org/10.1016/j.ijom.2015.04.007.
20. Posnick JC, Choi E, Chavda A. Operative Time, Airway Management, Need for Blood Transfusions, and In-Hospital Stay for Bimaxillary, Intranasal, and Osseous Genioplasty Surgery: Current Clinical Practices. J Oral Maxillofac Surg. 2016;74(3):590-600.https://doi.org/10.1016/j.joms.2015.07.026

