Abstract

Background. Bimaxillary orthognathic surgery may be complicated by excessive blood loss. What is of paramount importance for blood loss is operating time, segmentation of the maxilla, the expertise of the surgical team, the surgeon’s knowledge of anatomy. Furthermore, the patient should be correctly positioned so that the surgical field is kept above heart level [4].

Objectives. The aim of our study was to outline some factors which correlated with blood loss during orthognathic surgery.

Material and Methods. In our retrospective study we diagnosed laterognathia, micrognathia, laterogenia or mandibular prognathism in 18 patients (3 males and

Results. The mean operation time was 226.4 min (SD = 90.87; min time was 50 min, max 400 min) and the mean time of hospital residence was 6.81 days (SD = 1.88, min 3 days, max 12 days). In all the patients the average blood loss was 477 mL and varied from 50 mL to 1300 mL (SD = 282 mL). An average hemoglobin decrease was 1.38 ± 1.16 g/dL with the range from 0 to 3.9 g/dL per patient. A mean value of hematocrit (HCT) decrease was assessed at ± 3.81 ± 3.46% (min 0, max 11.3%). All these decreases were statistically significant.

Conclusions. As it proved in the present study it had the low rate of transfusion, severe bleeding that requires transfusion of allogenic blood has become the exception rather than the rule in orthognathic operations. All the investigated factors imply that there is no need to make routine blood transfusion even autotransfusion or any homotransfusion in orthognathic patients (Dent. Med. Probl. 2015, 52, 2, 144–149).

Key words: orthognathic surgery, blood loss, blood transfusion.

Słowa kluczowe: chirurgia ortognatyczna, utrata krwi, transfuzja krwi.
Blood Loss During Orthognathic Surgery

15 females; the average age was 25.5 years; the mean BMI was 23.1) from January 2010 to September 2011 in our department. All participants signed an informed consent agreement. Every single patient was ordered basic blood test ionogram before and 1 day after the surgical procedure. Blood pressure was examined before and after the operation. The operating time was calculated from the first incision to the last suture. All of the patients were healthy and had normal coagulation values (the average of APTT = 33.13 s, SD = 5.43; the average of INR = 1, SD = 0.19).

All the patients were asked for autotransfusion of their blood. For statistical analysis we divided the patients into 2 groups. We excluded patients who underwent the procedure of 1-jaw surgery because some surgeons claim that patients who had SSRO do not need blood transfusion [11]. Group one was composed of only 1 patient who underwent Le Fort I (1 woman) and the second group which consisted of 17 patients (3 men and 14 women) underwent 2-jaw surgeries (both bilateral SSRO and Le Fort I osteotomy). Thirteen patients donated blood for autotransfusion preoperatively (3 patient 0.290 l, 10 patients 0.580 l). In group 1 the patient did not consent to donate her blood for autotransfusion, in group two 13 of 16 patients donated their blood for autotransfusion.

Anesthesia was carried out by nasal intubation administering sevoflurane together with remifentanil which was induced intravenously in order to maintain controlled arterial hypotension. Hypocapnia was introduced to cause vasoconstriction [12]. In all the patients urinary bladder was catherized. Operating fields were injected with 1/200,000 solution of adrenalin at each site of incision. The incision was done 10 min after the injection. During surgery cristaloid solutions were performed. Blood was transfused when total blood loss had been more than 0.8 l and autotransfusion was possible.

In our statistical research (Statgraphics Centurion XVI, Statpoint, USA) we used the ANOVA test for blood loss for each of the 2 groups to find if there was a statistical significance between blood loss and the type of the procedure. We used simple regression between blood loss and many other factors such as hemoglobin decrease, hematocrit decrease, platelet decrease, blood transfused, in-surgery diurese, potassium ions decrease, chloride ions decrease and liquids transfused in order to assess the relationship between those values. Polynomial regression was used to find out how strong the relationship between liquids transfused and blood loss was.

T-test was used to assess the probability of average pre- and postoperative results of red blood cells, hematocrit, platelets, platelet distribution width (PDW), white blood cells, neutrophils, lymphocytes, monocytes, eosinophils, basophils, sodium ions, potassium ions and chloride ions were the same (null hypothesis). A probability of p less than 0.05 was considered statistically significant.

Results

The mean operation time in our 33 patients (female: male ratio 3:1) was 226.4 min (SD = 90.87; min time was 50 min, max 400 min) and the mean time of hospital residence was 6.81 days (SD = 1.88, min 3 days, max 12 days). In all the patients the average blood loss was 0.477 L and varied from 0.05 L to 1.300 L (SD = 0.282 L). There was a strong relationship (correlation coefficient = 0.64 with p < 0.001, R² = 41%, F = 21.43) between blood loss and duration of surgery as Fig. 1 shows. Fig. 2, the box-and-whisker diagram, indicates a comparison of the standard deviations in blood loss for each procedure.

As far as an average hemoglobin decrease was concerned it was 1.38 ± 1.16 g/dL with a range from 0 to 3.9 g/dL per patient. We found a relationship (relatively weak) between hemoglobin decrease and amount of blood loss (correlation coefficient = –0.45, p < 0.01, R² = 20%, F = 7.81). We made a simple regression to assess the relationship (Fig. 3). When it comes to a mean value of hematocrit (HCT) decrease, it was assessed as 3.81 ± 3.46%, with a min of 0 and a max of 11.3%. Statistically significant relationship between HCT decrease and blood loss was confirmed (correlation coefficient = 0.44, p < 0.01, R² = 20%, F = 7.61). We also measured the average of platelets (PLT) decrease which was 41.960 ± 36.780/µL with a range from 0 to 103.000/µL. And dependence on blood loss was significant (correlation coefficient = 0.50, p < 0.005, R² = 25%, F = 10.13).

The mean decrease of potassium ions was 0.21 mmol/L (SD = 0.171), with a range from 0.25 mmol/L to 0.45 mmol/L. The relationship was statistically significant (correlation coefficient = 0.39, p = 0.03, R² = 15, F = 5.44). The level of the potassium ions fell down (but within save range) because of hemodilution evoked by intravenousous liquids infusion during surgical procedure.

We made a simple regression for decrease of potassium ions and blood loss (Fig. 4).

The average decrease of chloride ions was evaluated at 1.73 mmol/L (SD = 1.873) with a range from 0 mmol/L to 5.3 mmol/L and it was statistically significant (correlation coefficient = 0.39, p = 0.025, R² = 15, F = 5.55). The outcome of the
Fig. 1. Results of simple regression analysis between blood loss and duration of operation. 
\( x \) – surgery duration [min]; 
\( y \) – blood loss [mL]; green lines – confidence limits

Fig. 2. Box-and-whisker diagram shows the spread of blood loss in two orthognathic procedures. 
\( x \) – blood loss [mL]; \( y \) – orthognathic correction

Fig. 3. Simple regression analysis between blood loss and hemoglobin decrease. In patients who lost more than 350 mL of blood autotransfusion was ordered. This is the reason why hemoglobin level is no longer decreasing. 
\( x \) – blood loss [mL]; 
\( y \) – HGB decrease [g/dL]; green lines – confidence limits

Fig. 4. Results of simple regression analysis between blood loss and the level of potassium ions after surgery. 
\( x \) – blood loss [mL]; 
\( y \) – K⁺ POST [mmol/L]; green lines – confidence limits

We made a polynomial regression to assess if there is a relationship between the liquid transfused and blood loss (Fig. 6). P-value equaled 0.0023, so there was a statistically significant relationship at a 95%-confidence level.

simple regression proves the increase in chloride ions together with blood loss as a result of simultaneous infusion of cristaloid or colloids solution (0.9% NaCl or 0.5% NaCl) when bleeding was observed (Fig. 5).
We tried to find the relationship between blood loss and blood transfused. With $p = 0.03$ (the ANOVA test) in the simple regression there was a relatively weak relationship between these variables (correlation coefficient equaled 0.38) (Fig. 7).

The average blood loss during all our procedures was $0.477 \text{ L (SD = 0.281 L)}$ with a range from 0.05 L to 1.300 L.

We have also found statistical significance ($p = 0.0038$) between diuresis during operation and blood loss. The average of in-surgery diurese equaled $0.171 \text{ L (SD = 0.281 L)}$ with a range from 0 to 0.7 L (Fig. 8).

In our patients the average red blood cells count decreases after the procedures equaled $0.46 \text{ m/mm}^3$ (SD = 0.36 m/mm$^3$) with a range from 0.02 to 1.28 m/mm$^3$ ($p < 0.05$).

The average of hemoglobin decrease was $1.38 \text{ g/100 mL (SD = 1.16 g/100 mL)}$ with a range from 0 to 3.9 g/100 mL ($p < 0.05$ in t-test).

The average of hematocrit decrease was $3.8 \text{ (SD = 3.47)}$ with a range from 0 to 11.3 (also $p < 0.05$ in t-test).

The patients’ average platelets amount decrease was $41.97 \times 10^3/\mu\text{L (SD = 36.78 \times 10^3/\text{micro-litr)}}$ with a range from 0 to $103 \times 10^3/\mu\text{L}$. We made pre-post surgery comparison by paired t-test.

The average white blood cells increase was $4.52 \times 10^3/\mu\text{L (SD = 2.85)}$ with a range from 0 to $5.8 \times 10^3/\mu\text{L}$. We used also t-test and confirmed that WBC increased after the surgical procedure (with $p < 0.05$).

The t-test also indicated that the amount of potassium ions, chloride ions and sodium ions decreased statistically significantly ($p$ for each ions decrease was less than 0.05).

Blood pressure had no statistical significance on blood loss. It was taken before and after the procedure. Moreover, it has occurred that blood loss did not depend on the operators who were specialists in maxillofacial surgery.

**Discussion**

Many methods have been used to reduce perioperative bleeding and the need for homologous blood transfusion [9]. Hypotensive anesthesia is an established and effective technique, and is particularly useful in maxillofacial surgery [13, 14]. There are very different opinions about the necessity for homologous blood transfusion. Despite the fact that intraoperative isovolemic hemodilution effectively reduces the need for transfusion of homologous blood, in some maxillofacial departments, autotransfusion is commonly performed. Neuwirth et al. [15] reported that patients receiving autologous blood transfusion after orthognathic surgery may benefit from the procedure by achieving a quicker return to full activity than nontransfused counterparts.
Marciani and Dickson [16], however, found that autodonation of blood has certain unavoidable drawbacks. The disadvantages are the loss of working time to donation procedures, the presence of microemboli, coagulopathy, the development of anemia and hypovolemia, and the possible mislabeling or mishandling of the donated unit.

According to Flood et al. [17] nearly 1/3 of patients who undergo bimaxillary surgery (Le Fort I and sagittal split osteotomies) require blood transfusion. Samman et al. [11] have found out that transfusion is not necessary for single-jaw surgery, although 27% of their bimaxillary osteotomy patients required transfusion. Ash and Mecerni [18] found that 75% of double-jaw surgeries with additional procedures required blood transfusion, and that 20% of double-jaw surgeries without additional procedures required blood transfusion [2].

Surgical procedures with additional procedures required blood transfusion, and that 20% of double-jaw surgeries without additional procedures required blood transfusion [2].

Reported that only 4 (0.8%) of the 506 bimaxillary surgery patients they studied received blood transfusion, and that the average estimated blood loss was 0.975 L. In our study 35% (6 of 17) of double-jaw surgeries with additional procedures had blood transfusions.

There are clear differences in the amount of blood loss between the above studies.

The criteria for transfusion have changed during the last decades.

According to Steinhauer et al. [19] and Gordy et al. [20] blood loss in bimaxillary orthognathic operations is usually between 0.4 and 0.6 L and transfusion should not be considered in a patient with no major health impairment. Moreover, hemoglobin values between 7 g/dL and 8 g/dL are acceptable in healthy patients in contrast to earlier recommendations [1, 2, 4, 21–23]. According to recent recommendations the indication for transfusion was a hemoglobin value below 7.0 g/dL or a hematocrit level below 20% [2, 21, 22, 24]. In our study, despite the fact there was no single patient who had HGB < 7.0 g/dL or HCT < 20%, we had 10 patients who underwent autotransfusion after the operation.

There was a relatively weak relationship between blood loss and blood transfused (p = 0.03) because some of the patients (7) did not donate their blood for autotransfusion and as a result 4 of them were not given blood despite losing more than 0.6 L of blood. Had they donated their blood before the procedure, the correlation coefficient would have been higher.

The correlation between diuresis during operation and blood loss (p = 0.0038) was most likely caused by the crystaloids infusion which triggered diuresis.

Blood that is taken for autotransfusion and would not be transfused to the patients is useless.

We suggest blood for autotransfusion should be drawn only from the risk patients. In the majority of the patients any transfusion is necessary.
As we proved in the present study we had the low rate of transfusion, severe bleeding that requires transfusion of allogenic blood has become the exception rather than the rule in orthognathic operations. Thus, there is no need to make routine blood autotransfusion or any homotransfusion in orthognathic patients.

Acknowledgment. The database in this article was created as a control group that will be compared to the patients that will undergo orthognathic procedures with 3D planning. The article with 3D planning of orthognathic procedures will be funded from the 2014–2016 year budget as the scientific project of “Diamond Grant” [nr 0117/DIA/2014/43].

References


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Conflict of interest: None declared

Received: 5.10.2014
Revised: 15.12.2014
Accepted: 11.01.2015