

Role of Hypotensive Anaesthesia in Orthognathic Surgery

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CERTIFICATE

This is to certify that this dissertation titled “**ROLE OF HYPOTENSIVE ANEASTHESIA IN ORTHOGNATHIC SURGERY**” is a bonafide record of work done by **Dr. MEENAKSHI VIDHURAN** under my guidance during her postgraduate study period between 2002-2005.

This Dissertation is submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, in Partial fulfillment for the Degree of **MASTER OF ORAL AND MAXILLOFACIAL SURGERY, BRANCH I**. It has not been submitted (partial or full) for the award of any other degree or diploma.

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INTRODUCTION

Orthognathic surgeries are frequently performed to correct dentoskeletal anomalies- hereditary and acquired. The procedure is standardized and yields predictable, stable results. However, the procedure is invasive and associated with considerable blood loss. Bleeding occurs from soft tissue, intrabony vessels and capillaries, which cannot be ligated. Hence, induced hypotension is widely recommended ²⁸.

J.E. Moenning et al ²³, D.S. Precious et al ³⁶, Robert M. Dolman et al ³⁸ and Nabil Samman et al³¹ have done studies on the effect of induced hypotensive anaesthesia on orthognathic surgery.

Induced hypotension is a decrease in mean arterial pressure to 55-65mm Hg under general anaesthesia in normotensive patients ⁴¹. It is the deliberate induction of hypotension during anaesthesia in an attempt to produce a controlled and safe reduction in intravascular pressure in order to reduce blood loss.

Deliberate or controlled or induced hypotensive anaesthesia is widely used in neuro, plastic, head & neck, orthopaedic and oncological surgeries. Hypotension not only reduces blood loss, but also improves the surgical field. Thus, leading to more accurate surgery and decreased operative time.

Though widely recommended, due to lack of trained anaesthetists and proper monitoring equipment it is not universally practiced.

Orthognathic surgeries have been done under normotension in Ragas Dental College and Hospital till the year 2001. Since then hypotension has been implemented for all the orthognathic surgeries. We undertook this study to compare the relative advantages of this measure.

LITERATURE REVIEW

W. James Gardner 1946 introduced arteriotomy. In this procedure blood was withdrawn from the patient preoperatively via the arterial route and then replaced in part or intoto by the same manner at the end of operation. This reduction in total circulating blood volume leads to lowering of blood pressure and peripheral vasoconstriction. Hence, decreased blood loss perioperatively.²¹

Mc Neill TW, De Wald RL 1974 et al did a retrospective study, comparing normotensive (22 patients) and hypotensive (44 patients) anesthesia for spine fusion. The use of hypotensive anaesthesia was found to decrease the need for blood replacement and total blood loss by an average of 40% and to reduce the average operating time by more than 30 min. No complications attributable to anesthetic technique occurred.³²

Schaberg, Kelly JF, Terry BC 1976 has evaluated effect of sodium nitropurisside infusion supplemented with halothane in oro-facial corrective surgery. Various physiological parameters were measured pre operatively, intraoperatively and post operatively to evaluate patient response to this anaesthetic method. The mean artificial pressure was reduced from 89.94 ± 2.13 to 72.79 ± 1.63 mg under the influence of sodium nitropursside. It is concluded from an extensive review of the literature that the most vulnerable period for serious complication is in the immediate postoperative period. No significant complications were observed in this study⁴¹

Kerr AR. in 1977 produced a blood-free field for middle ear surgery performed with the operating microscope; the arterial systolic pressure was reduced to less than 50 mm Hg in 700 patients by means of thiopentone-halothane-nitrous oxide in oxygen anaesthesia together with pentolinium

tartrate. In 84% the results were excellent, in 12% moderately good and they were poor in 4%. There were more unsatisfactory results in males (22.8%) than in females (11.4%). In spite of the arterial pressure being reduced to very low values in many instances, there was no mortality or morbidity, which could be ascribed to the technique²⁴

Thompson GE, Miller RD, Steven WC 1978 attempted to determine effect of hypotensive anaesthesia on post operative brain, liver, kidney and myocardium following total hip arthroplasty. MAP was decreased to 50 torr using high concentrations of halothane or sodium nitroprusside. In control group, MAP was maintained with 20% base line. Intraoperative blood loss decreased from 1,183±172ml normotensive to 406±102ml and 326±41ml in halothane and nitroprusside hypotensive groups respectively. Neither method effected the cerebral, hepatic or renal and myocardial function. There was no morbidity. Operating time was significantly reduced. Decreased blood loss lead to decrease in number of blood transfusions needed.⁴⁶

Gallagher DM, Milliken RA 1979 reported that achieving satisfactory hemostasis during orthognathic surgery might be difficult because of the extensive vascularity of facial structures. Hypotensive anaesthetic techniques provide clear operative field by altering regional tissue perfusion through the use of systemic vasodilators, ganglionic blocking agents and positioning of the patient. Through

monitoring during surgery, careful selection of patients, and close communication between the surgery and anesthesiologist permit safe anaesthesia, can decrease operating time, and usually obviate the need for transfusion.¹¹

Vandesteene, Mouawad, Noterman *et al.* 1980 et al have used sodium nitroprusside 0.01% solution to induce hypotensive state. Mean dose to maintain a mean blood pressure at about 50 Torr was 1.37 mcg/kg/min. The patients were operated for cerebral aneurysm or angioma. Adjuvant drugs and methods to reduce intracranial pressure such as dexamethasone, mannitol & cerebro-spinal fluid subtraction were used⁴⁹.

Sivarajan M. Amery DW, Everett GB *et al* 1980 emphasized that blood pressure and not cardiac output, determines blood loss during induced hypotension. Cardiac output characteristically decreases during trimethaphan infusion but is well maintained or increased during sodium nitroprusside infusion. They postulated that at similar levels of mean arterial pressure, sodium nitroprusside might be associated with greater blood loss than trimethaphan due to the increase in cardiac output. They studied 20 young healthy patients scheduled for bilateral sagittal osteomies of the mandible. Ten subjects received trimethaphan and 10 subjects received sodium nitroprusside. Using halothane (0.5 – 1%) & N₂O (60%) for maintenance of anaesthesia, trimethaphan or sodium nitroprusside was infused to maintain mean arterial pressure between 55-60mm Hg; cardiac output was measured

in five subjects in each group. Heart rate and cardiac output increased significantly and total peripheral resistance decreased significantly, during sodium nitroprusside infusion when compared to trimethaphan duration of hypotension or in blood loss. They conclude that operative blood loss during induced hypotension is determined by mean arterial pressure not cardiac output.⁴²

Chan W, Smith DE, Ware WH 1980 compared the blood loss, quality of operative field and the length of surgery in one type of orthognathic surgery – anterior maxillary osteotomy in normotensive and hypotensive anaesthesia. They found that by dropping a patients operative mean blood pressure below his mean blood pressure by 20% or more, the quality of the surgical field can be significantly improved (27%) and loss of blood can be decreased (41%).⁵

Ward CF, Alfery DD, Saidman J 1980 have described the effect of blood pressure reduction on organ perfusion, when deliberate education of blood pressure to reduce intraoperative blood loss was used.⁵⁰

Bergman S, Hoffman WE, Gans BJ, Miletich DJ, Albrecht RF 1982 Hypotensive anesthesia is currently being used in oral and maxillofacial surgery to reduce blood loss and provide a relatively bloodless surgical field. Radioactively labeled microspheres were used to determine

and compare the hemodynamic effects of sodium nitroprusside (SNP), nitroglycerin (NTG), and deep enflurane anesthesia on oral tissues during controlled hypotension when compared with controls. Sodium nitroprusside and NTG produced significant reductions in blood flow to the maxilla, mandible, and tongue, while deep enflurane anesthesia did not. In the masseter and suprahyoid muscles, increases in tissue blood flow were found with SNP and enflurane. Nitroglycerin produced no significant change in blood flow in the masseter and the suprahyoid. These results demonstrate that in spite of a similar cardiac index with all agents tested, local oral blood flow varied significantly with the different agents tested. These differences in tissue blood flow suggest that SNP and NTG may be preferable to deep enflurane anesthesia for maxillary osteotomies to achieve greater flow reduction and diminish blood loss.²

Fahmy S 1983 substituted enflurane for halothane to induce controlled hypotension, along with B-blockers and sympathetic ganglion blockers, in two groups. They constituted 1) major maxillofacial surgery 2) major neurosurgery. All patients were carefully monitored during anaesthesia and for 24 hours postoperatively. Good operative conditions were produced and no ill effects of controlled hypotension were detected in any of the patients⁹

Beierholm WE, Bregaard Sorensen M, Sroczyanskiz Z et al 1983 studies the haemodynamic effects of sodium nitroprusside in 6 patients undergoing surgery for intracranial aneurysm under controlled hypotension in endotracheal anaesthesia with halothane – nitrous oxide during hypocapnia mean arterial pressure was reduced with SNP from mean 12.25 Kpa to mean 8.29 Kpa (32%). There were concomitant statistically significant heart rate, central venous pressure and pulmonary vascular resistance did not change significantly. After the infusion of SNP was discontinued all parameters, except cardiac index & heart rate, returned to values not significantly different from the control values. The hypotension induced by SNP resulted from reductions in cardiac index and systemic vascular resistance. The reduction in cardiac index did not reach a critical level in any of the patients. ¹

Lam AM, Gelb AW in 1983 Deliberate hypotension was induced with isoflurane in 13 patients, undergoing craniotomy for clipping of aneurysms. Cardiovascular function and gas exchange were monitored before, during, and after hypotension. In all cases, the desired level of hypotension [40 +/- 1 (SEM) mm Hg] was achieved readily with prompt onset (5.7 +/- 1.0 min) and recovery (6.3 +/- 0.7 min). Cardiac output during

hypotension (4.6 +/- 0.3 L/min) was not significantly different from the control normotensive value (4.80 +/- 0.3 L/min). Gas tensions during hypotension and during normotension were; PaO₂ 116 +/- 6 and 111 +/- 8 mm Hg; PaCO₂ 33 +/- 1 and 34 +/- 1 mm Hg; respectively. No complication could be attributed to the use of isoflurane. We conclude that isoflurane can be employed safely and effectively as a hypotensive agent in neurosurgery ²⁵

Golia JK, Woo R, Farole A, Seltzer JL 1985 has used nitroglycerin for controlled hypotension in orthognathic surgeries. Nitroglycerine (NTG) was chosen because of its beneficial cardiovascular effects and its lack of toxicity as compared with sodium nitroprusside nine patients undergoing either maxillary or maxillary / mandibular osteotomies were anaesthetized with halothane, N₂O, O₂ & supplemental doses of a muscles relaxant and narcotic. NTG was used to lower mean arterial pressure during periods of potential increased blood loss. Estimated blood loss was 439 + / - 1.19 ml. The hemoglobin and hematocrit fell slightly from 13.8 + / - 1.74 gm/dl / and 41.2 + / - 5.11% to 12.04 + / - 1.8 gm/dl and 35.6 + / - 4.9%. Alteration of the pulmonary hypoxic vasoconstriction reflex was also seen as was evidenced by a decrease in PaO₂ after NTG administration. It was concluded that NTG is a safe and efficacious agent for controlled circulation during maxillary osteotomy surgery ¹²

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Guggiari M, Dageou F, Lienhart A, Gallais S, Mottet P, Philippon J, Viars P in 1985 The cardiovascular effects of nitroglycerine (TNG) were studied in 30 patients requiring controlled hypotension for intracranial aneurysm surgery. In patients "resistant" to TNG (n = 9), sodium nitroprusside (SNP) was used to supplement the TNG. With TNG alone at a total dose of 31 mg and mean hypotension duration of 28 min, mean arterial pressure (MAP) decreased by 43%, from 78.3 to 44.4 mm Hg as a result of decreases in cardiac index (CI) (18%) and systemic vascular resistances (SVR) (21%). Simultaneously, a moderate increase in (Cao₂ - Cvo₂) (21%), and a significant increase in plasma renin activity (90%) were observed. In patients "sensitive" to TNG, the MAP decreased by 54%, CI by 27% and SVR by 35%; HR remained stable. In patients "resistant" to TNG, the decreases in CI and SVR were less marked: 2% and 22% respectively; the observed increase in HR was 12%. When non-toxic doses of SNP were used (less than 2 micrograms kg⁻¹ min⁻¹), hypotension was caused by decreased SVR (31%) and increased CI (8%). TNG alone can be used to produce controlled decreases in MAP to around 50 mm Hg, and in patients "resistant" to TNG, SNP can be added to increase the hypotensive effect.¹⁷

MacRae WR. In 1985 The use of induced hypotension in the hands of a competent anaesthetist combined with the careful technique of a surgeon skilled in operating under these conditions can aid surgical access, improve delineation of pathology, and reduce levels of blood loss, all of which are to the advantage of the patient. These advantages should encourage surgical and anaesthetic teams to become accomplished exponents of the art²⁷

Gourdeau M, Martin R, Lamarche Y, Tetreault L. in 1986 Oscillometry using an automatic monitor was compared with invasive blood pressure monitoring in 21 patients scheduled for surgery under general anaesthesia with deliberate hypotension. Six ranges of mean blood pressure measurements were studied, two of which were hypotensive. An excellent correlation was found between the two methods (systolic: $r = 0.94$; mean: $r = 0.93$; diastolic: $r = 0.88$) but there was a large variability among individual subjects. For systolic, diastolic and mean intra-arterial readings above an approximate value of 10.64 KPa (80 mmHg), the oscillometric monitor was found to underestimate blood pressure. Inversely, it was found to overestimate blood pressure for intra-arterial readings under the approximate value of 10.8 KPa (80 mmHg). We conclude that the non-invasive monitor represents a good trend estimation of the invasive radial blood pressure

technique, but that wide inter-individual variability and the overestimation of blood pressure below an approximate value of 10.64 KPa (80 mmHg) precludes interchange of techniques when absolute values are considered, especially during controlled hypotension. However, oscillometry could represent a better estimate of central aortic pressure.¹⁶

Pasch T, Huk W in 1986 Over an 8-year period (1977-1984), 1,802 otorhinolaryngological procedures were performed under controlled hypotension. Four patients showed symptoms of cerebral damage post-operatively. One patient had pre-operative unrecognized stenosis of the internal carotid artery, another a hypoplastic vertebral artery. In this female patient, the head had been strongly rotated to the side to expose the surgical field, and the internal jugular vein removed. She died of general ischaemic brain damage on the seventh post-operative day. In the remaining two patients, symptoms of cerebral ischaemia did not occur until the third and eleventh day, respectively, so that the causative role of hypotensive anaesthesia is uncertain. The cases described represent a cerebral morbidity of 4:1,802 (0.22%) and a mortality of 1:1,802 (0.06%). It is concluded that controlled hypotension is a safe technique if the indication is stringently applied, and any risk-bearing factors are carefully excluded³³

Campkin TV, Flinn RM in 1986 The use of isoflurane to induce arterial hypotension was studied in 40 adults undergoing neurosurgery. In 70% of patients, isoflurane, up to 2.0% (inspired), decreased mean arterial pressure (MAP) to the desired level for surgery; for the remainder, a higher concentration (3.0-4.0%) was required. Tachycardia, which could be slowed by labetalol, occurred in 13 patients (32%); the incidence was significantly higher in those who had not received an opiate either as premedication or intra-operatively. No post-operative complications attributable to hypotension were seen. It is concluded that isoflurane is a safe and effective agent for the induction of hypotension in neurosurgical operations ⁴

Myron Yaster MD, Raymond S Simmons, Veinon T, Tolo, James M et al 1986 compared nitroglycerin and nitroprusside for inducing hypotension in children by conducting a double blind study. NTG is doses as high as $40 \text{ mg kg}^{-1} \text{ min}^{-1}$ was in effective at decreasing mean arterial pressure below 55 mm Hg or causing a decrease in MAP greater than $1/3^{\text{rd}}$ of base line values. SNP was uniformly successful at inducing hypotension in all patients; inducing those patients in than NTG failed. NTG & SNP decreased systemic vascular resistance, although SNP did so to a much greater degree. Both drugs reflexly increased heart rate, necessitating the use of propranolol, and decreased arterial oxygen tension to a small extent.

SNP appears to be the agent of choice for the reliable and sustained induction of deliberate hypotension in children and adolescents.³⁰

Sollevi A. in 1988 Controlled hypotension reduces blood loss during defined major surgical procedures, which in turn will minimize transfusion needs and thereby the risks of transmission of infectious diseases. There is no evidence that hypotension below 8 kPa (60 mmHg) (MAP) is associated with better blood-sparing effects than a more moderate hypotension, but it will probably increase the risk of cardiovascular complications. Therefore, controlled hypotension, being a sophisticated technique, requires handling by an experienced anesthetist well aware of contraindications and the need for adequate monitoring for prevention of tissue ischemia. Large randomized and prospective studies are still warranted, especially for further evaluation of the risk-benefit with controlled hypotension. ⁴³

Lessard MR, Trepanier JP, Basinault JG, Brochu et al 1989 studies the effect of isoflurane induced hypotension on reduction of blood loss, improvement of surgical field, and postoperative edema in 52 patients undergoing combined maxillary and mandibular osteotomies. Blood loss in the hypotensive group (MAP – 55 to 65 mm Hg) was significantly less than that in the control group (MAP – 75 to 85 mm Hg); 454 + / - 211.3 ml Vs 755.3 + / - 334.6 ml (fewer patients had to be transfused in the hypotensive

group 12% Vs 44.4%. The surgical field improved significantly, but operative time was not shortened. Subjective and objective measurements of postoperative edema failed to show any effect of deliberate hypotension. They concluded that enflurane-induced hypotension effectively reduces blood loss and the number of transfusion in orthognathic surgery.²⁸

J.E. Moenning, DA Bussard, Thomas H. Lapp 1995 did a retrospective study comprising 506 patients who under went orthognathic surgery both single and double jaw. Average estimated blood loss for all groups was 273.23 ml. Double jaw surgery resulted in more blood loss than single jaw procedure. Men & boys bled more than women & girls. Only 0.8% received blood transfusion. They concluded that for reducing blood loss are hypotensive anaesthesia, single surgical team and constant surgical setting.²³

Precious DS, Splinter W, Bosco D 1996 had compared blood loss, quality of surgical field, and duration of procedure in normotensive and hypotensive anaesthesia in adolescent orthognathic surgery patients. Sample size was 25 in each group. Results showed significant decrease in blood loss, better surgical field with no significant difference in duration of the procedure with induced hypotensive anaesthesia.³⁶

Nabil Samman, Lim Kwong Cheung 1996 qualified the blood loss & transfusion requirements in orthognathic surgery by a retrospective study, comprising 360 healthy orthognathic surgery patients. Estimated blood loss ranged from 50 to 5,000 ml, 24% were transfused. 8.7% - single jaw surgery and iliac bone harvest 26.7% after bimaxillary surgery.³¹

Guyuron B, Vaughan C, Schlecter B in 1996 Desmopressin (1-deamino-8-D-argininevasopressin, DDAVP) is a synthetic analog of the antidiuretic hormone L-argininevasopressin. DDAVP has been shown to increase the plasma concentration of endothelial factor VIII, thus increasing coagulant activity. There is evidence from controlled clinical trials indicating that DDAVP can reduce blood loss and transfusion requirements for individuals with normal coagulation profiles undergoing various surgical procedures. This study was conducted to evaluate the efficacy of the DDAVP in reduction of blood loss during orthognathic surgery. Twenty patients, 15 females and 5 males, undergoing bimaxillary osteotomy were randomized into two groups of ten. Perioperatively, group 1 patients received 20 micrograms of DDAVP infused over one-half hour. Group II patients did not receive DDAVP. Hypotensive anesthesia (mean arterial pressure < 60 mm Hg) was routinely employed for both groups. On average,

the blood loss in group I patients was 144 ml less per patient than group II patients ($p < 0.50$). Only 2 of 10 patients in group I lost in excess of 750 ml, while 6 to 10 group II patients experienced blood loss greater than 750 ml ($p < 0.20$). The average postoperative hematocrit for patients in group I dropped by 6.17 of the preoperative mean hematocrit ($p < 0.001$). The average drop in hematocrit among the group II patients was 11.61 ($p < 0.001$). When collated, this hematocrit drop of 11.61 for group II and 6.17 for group I (recipients of DDAVP) proved to be significantly different ($p < 0.01$). It is concluded from this study that patients receiving a standard dose of DDAVP prior to bimaxillary osteotomy would experience reduced intraoperative blood loss, providing that blood pressure is well controlled and fluid replacement is carefully managed. No significant adverse side effects of desmopressin acetate were observed¹⁸

Van de Perre JP, Stoelinga PJ, Blijdorp PA, Brouns JJ, Hoppenreijns TJ in 1996 The data of 2049 patients, who underwent maxillofacial orthopaedic surgery, were retrospectively analysed for major intra- and immediate postoperative complications. Immediate life-threatening complications were very rare. They can in most cases be avoided by good anaesthetic and surgical techniques and adequate postoperative care. The most frequently encountered problem in maxillary surgery is

excessive blood loss, whilst a compromised airway due to swelling is the most frequent complication in mandibular surgery. Good co-operation between anaesthetist and surgeon is essential to prevent major intraoperative and immediate postoperative problems.⁴⁸

Enlund MG, Ahlstedt BL, Andersson LG, Krekmanov LI in 1997

The need for induced hypotension in orthognathic surgery was evaluated. Blood loss, duration of operation, quality of the surgical field, and surgical result were measured in 36 patients, assigned to either hypotension (mean arterial pressure, MAP, 50-64 mmHg) or normotension (MAP $>$ or $=$ 65 mmHg). Hypotension was achieved by increasing the amount of isoflurane given. The hypotensive group had significantly less bleeding over time (mean 0.9 ml/minute, 95% confidence interval (CI) of mean 0.6 to 1.2, compared with 1.8, 95% CI 1.3 to 2.4, $p = 0.005$). The corresponding difference in total blood loss did not differ significantly between the groups (mean 186 ml, 95% CI 98 to 275, compared with 304ml, 95% CI 210 to 399). No patient required transfusion of red cells. Neither the duration of surgery, nor the quality of the surgical field, or the final results were significantly influenced by hypotension. The clinical relevance of induced hypotension in orthognathic surgery must be considered to be doubtful. A

mean reduction of less than 150 ml will be of limited value at the low levels of blood loss reported ⁸

Robert Dolman, Kenneth Bentley, Timothy Head 2000 have done a prospective study to compare quality of surgical field, blood loss & operative time with either hypotensive or normotensive anaesthesia during Lefort I osteotomies. There was a significant correlation between ($p < 0.0001$) surgeries perception of quality of surgical field & the blood pressure. Statistically significant reduction in blood loss ($p < 0.01$) when using hypotensive anaesthesia. No significant reduction ($p = 0.44$) in operative time.³⁸

R.G. Rohling, P. Simmermann, P. Biso 1999 have described a protocol of blood-saving measures, which was rested on a sample of 127 patients treated between 1994 & 1997. The protocol comprises acute normovolemic hemodilution, controlled moderate hypotension, positioning the surgical field above the heart level, cell saving, intra operative homeostasis, pre operative autologous blood donation, administration of recombinant erythropoietin, and acceptance of a low hematocrit perioperatively. This study showed that homologous blood transfusion might be awarded intra operatively by following the protocol.³⁹

CNF Yu, TK Chow, Ask KWA 2000 in their prospective study including 32 patients undergoing orthognathic surgery under induced hypotensive an aesthesia found that mean estimated blood loss for double jaw surgery was 617.6ml mean EBL during Lefort I was half that of multiple segmentalised osteotomies for mandibular ramus osteotomies, mean BBL and operating times was 280 ml and 2 hours respectively, for anterior mandibular osteotomies the corresponding values were 171.3 ml and 1 hour 13 minutes. Average drop in haeratocrit value was 15.4%. A bivariate correlation test between the blood loss and operating time are a strong correlation ($p<0.01$), as did blood loss with a drop in haematocrit value ($p<0.01$). Orthognathic surgeries are thus safe and predictable in terms of intra operative blood loss and operating time.⁵¹

Ekback G, Axelsson K, Ryttberg L, Edlund B, Kjellberg J, Weckstrom J, Carlsson O, Schott U in 2000 Intraoperatively administered, tranexamic acid (TA) does not reduce bleeding in total hip replacement (THR). Therefore, its prophylactic use was attempted in the present study because this has been shown to be more effective in cardiac surgery. We investigated 40 patients undergoing THR in a prospective, randomized, double-blinded study. Twenty patients received TA given in two bolus doses

of 10 mg/kg each, the first just before surgical incision and the second 3 h later. In addition, a continuous infusion of TA, 1.0 mg. kg⁻¹. h⁻¹ for 10 h, was given after the first bolus dose. The remaining 20 patients formed a control group. Both groups used preoperative autologous blood donation and intraoperative autotransfusion. Intraoperative bleeding was significantly less (P: = 0.001) in the TA group compared with the control group (630 +/- 220 mL vs 850 +/- 260 mL). Postoperative drainage bleeding was correspondingly less (P: = 0.001) (520 +/- 280 vs 920 +/- 410 mL). Up to 10 h postoperatively, plasma D-dimer concentration was halved in the TA group compared with the control group. One patient in each group had an ultrasound-verified late deep vein thrombosis. In conclusion, we found TA, administered before surgical incision, to be efficient in reducing bleeding during THR. Implications: In a prospective, double-blinded study of 40 patients undergoing total hip replacement, the preoperative administration of tranexamic acid reduced bleeding by 35%, probably by decreasing induced fibrinolysis. Whether tranexamic acid therapy can replace predonation of autologous blood or intraoperative autotransfusion requires further study. ⁷

Stewart A, Newman L, Sneddon K 2001 have done randomized, placebo controlled, double blind trial (each 15), giving Apotronin intravenously (200ml) before the operation and then 50 ml per hour until the

end of the operation during simultaneous Lefort I and mandibular sagittal split osteotomies, lost 52% less blood than controls. EBL in apotronin group was 473 ml compared with 986 ml in controls. Blood was transfused in 1 patient in apotronin group compared to 9 in control group. No complications due to drug encountered. ⁴⁵

.Goran Zellin, Lars Rasmusson, Jan Palsson, K E Kahnberg in 2004 determined whether the addition of hemorrhage depressors to other medication during orthognathic surgery would further reduce the blood loss. Thirty patients undergoing Lefort I osteotomy were studied, one group was operated under hypotension anaesthesia, the other under received additional hemorrhage depressors, tranexamic acid and desmopressin. The results showed statistically significant reduction of blood loss in the treatment group ($P < 0.01$). They concluded that blood loss during orthognathic surgery under hypotensive anaesthesia could be significantly reduced when a combination of tranxemic acid and desmopression is added. ¹⁴

CONCLUSION

Though the sample size was limited, we infer the following from our study.

- 27% reduction in blood loss when induced hypotension was used.

- No significant reduction in the operative time when hypotensive anaesthesia was used.
- Nitroglycerine can be used as a safe drug to induce hypotension

This is an ongoing study. When the target sample size of 100 is achieved, more statistically relevant conclusion can be inferred from the study.

Induced hypotension continues to be a justifiable and useful technique in selected cases, however the inherent risks must not be underestimated.

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