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Hypotensive Anesthesia in Orthognathic Surgery-A Review

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Abstract: *Orthognathic surgeries are major surgical procedures carried out to treat dentofacial deformities involving the maxilla, the mandible or both in combination. Orthognathic surgeries are complex surgical procedures for which a considerable amount of blood loss is expected due to the high vascularity of the facial skeleton, resulting in the need for blood transfusion. Blood transfusions are generally considered to be safe. But they do carry some risk of complications such as fever, chills, urticaria, anaphylactic reactions and transmission of bacterial, viral or protozoal infections. Various methods have been employed in reducing perioperative blood loss and transfusion requirement. One of the methods is controlled hypotension during anesthesia or hypotensive anesthesia. The aim of this article is to provide an overview of hypotensive anesthesia in patient undergoing orthognathic surgery.*

Keywords: *Orthognathic surgery, Hypotensive anesthesia, Blood loss.*

I. Introduction:

Orthognathic surgery basically involves planned fracturing of the facial bone parts and repositioning them as desired for the correction of dentofacial deformities [1]. Due to the abundance of vascularity to the maxillofacial region, these surgical procedures result in blood loss that can require blood transfusion [2]. Blood transfusion is associated with number of complications including transmission of bloodborne pathogen or potential risk of a transfusion reaction. With the application of hypotensive anesthesia in bimaxillary surgery intraoperative loss of blood is considerably reduced and requirement of blood transfusion is significantly decreased [3, 4, 5]. This article reviews the role of hypotensive anesthesia in patients subjected to orthognathic surgery for dentofacial deformity treatment.

II. Definition

Hypotensive anesthesia is a state of induced controlled hypotension during anesthesia to reduce bleeding and improve the surgical site adjusted to the patient's age, preoperative blood pressure and past medical history.

III. History

Hypotensive anesthesia was first used by Harvey and Cushing [6] in 1917 for intracranial surgeries and introduced in clinical practice by W. James Gardner in 1946[7].Gardner introduced the method of hypotensive anesthesia using arteriotomy procedure. In this procedure patient blood was collected preoperatively by the arterial route and then replaced in part or in Toto by the same method by the end of surgery. This reduction in total circulating blood volume leads to decreased blood pressure and peripheral vasoconstriction, resulting in a relatively bloodless surgical field. The first study of hypotensive anesthesia in maxillofacial corrective procedure was reported by Schaberg et al in 1976[3, 8].

IV. Blood Pressure Goal In Hypotensive Anesthesia

The aim of hypotensive anesthesia is to minimize blood loss and provide a favorable surgical field to operating surgeon. Each individual has a range of blood pressure, so that degree of hypotensive anesthesia should be individualized in relation to the patient's preoperative blood pressure rather than to a specific target blood pressure. In hypotensive anesthesia, a mean arterial blood pressure (MAP) is reduced 30% below to the patient's usual MAP. Consequently, the systolic blood pressure is reduced to 80-90 mmHg and the MAP is reduced to 50-65 mmHg in normotensive patient [9].

V. Methods Of Achieving Hypotensive Anesthesia

The main objective of hypotensive anesthesia is to reduce the MAP.MAP can be manipulated by reducing either cardiac output or systemic vascular resistance or both. Inducing hypotension purely by decreasing cardiac output is not an ideal method, because the maintenance of adequate blood flow to organ is essential .Systemic vascular resistance can be reduced by peripheral vasodilatation of the resistance blood vessels. In orthognathic surgeries maintaining MAP between 50-65 mmHg significantly reduce the blood loss and provide favorable surgical field. Various methods used to achieve hypotensive anesthesia are discussed below.

5.1 Mechanical maneuver to induce hypotensive anesthesia:

Anti-Trendelenburg position or Head up position is frequently used for hypotensive anesthesia. By placing the patient in this position allows easy drainage of venous blood from the surgical site. Head up of 15^0 to 25^0 off the horizontal plane facilitates blood flow in the dependent body parts, thus reducing venous return. Hypotensive effects of most of the hypotensive agents are potentiated by postural changes. Blood pressure fall of 2 mmHg can be achieved by elevation of the surgical site above the heart for each 2.5cm [1].

5.2 Pharmacological agents:

Many pharmacological agents have been used alone or in combination to induce controlled hypotension during orthognathic surgery. The ideal hypotensive drug for inducing deliberate hypotension should be easy to administer, with a rapid onset and recovery, dose can be meticulously controlled, rapid elimination without toxic metabolites or adverse effects and negligible effects on vital organs.

5.2.1 Volatile anesthetic drugs:

Most volatile anesthetic agents such as halothane, isoflurane, enflurane, sevoflurane, and desflurane have a vasodilator action and have been used to induce hypotension during anesthesia. Halothane induced hypotension mainly by myocardial depression. Hypotension with enflurane results by a combined effect of decreased peripheral vascular resistance and myocardial depression. Effect of volatile agents such as isoflurane, sevoflurane, and desflurane are equal in their ability to reduce blood pressure. Main disadvantage of these agents are when used alone, higher concentration are required to produce adequate control in intraoperative bleeding. Higher concentration use of volatile agents may leads to hepatic or renal injury. It is best to use volatile anesthetic agents as adjuvant drugs rather than using them as a prime agent during hypotensive anesthesia [1].

5.2.2 Propofol:

Intravenous anesthetic agent, Propofol has a potent hypotensive capability. Several studies have shown that short term propofol infusion is safer than long term propofol infusion. A study by Ankichetty et al compared using isoflurane to propofol for hypotensive anesthesia exhibits there is no significant difference noted in terms of intraoperative bleeding and surgical field condition [10].

5.2.3 Opioid drugs:

Opioids such as alfentanil, sufentanil, and remifentanil are potent, short acting synthetic drugs used to produce anesthesia and hypotension. These synthetic opioids are better than other opioid analgesics, such as meperidine and morphine, in terms of maintain hemodynamics during orthognathic surgery.washburn et al[11] in their study used morphine and halothane to induce deliberate hypotension in elective maxillofacial surgeries which conclude favorable operation site and decreased operation time due to less bleeding and no patients required blood transfusion.

5.2.4 Direct acting vasodilators:

Sodium nitroprusside and nitroglycerine are most common nitrates used for inducing hypotensive anesthesia in a variety of procedures including orthognathic surgery. Sodium nitroprusside use was first reported in 1962 for inducing hypotensive anesthesia [1]. Both sodium nitroprusside and nitroglycerine acts directly on vascular smooth muscles and relaxes them resulting in decreased venous return and cardiac output. These drugs should be used carefully during surgery, any wrong titration may result severe hypotension. The hypotensive effect of nitrates can be quickly reversed by discontinuing its infusion. Main adverse effect of nitrates is reflex tachycardia which can be prevented by a small dose of beta adrenoceptor antagonist as preanesthetic medication.

5.2.5 Beta adrenoceptor blocking agents:

The beta adrenoceptor blocking agent are used alone or in combination with sodium nitroprusside for inducing hypotensive anesthesia.Labetalol is an antihypertensive drug which has combined alpha and beta receptor antagonism.Labetalol action is more potent at beta receptor than in alpha adrenoceptor. It can be given in small intermittent bolus doses or by infusion. Onset of action is within 5 minutes and half life is relatively long at 4 hours.Labetalol has remarkable hypotensive synergism with volatile agents, such as halothane and isoflurane.McNulty et al [12] reported in their study that the labetalol is a safer and effective alternative for inducing hypotensive anesthesia in orthognathic surgery.

5.2.6 Calcium channel blockers:

Calcium channel blockers such as nicardipine, nifedipine, diltiazem and verapamil have been used to produce controlled hypotension.Nicardipine is used most commonly for hypotensive anesthesia it is sufficiently water soluble and can be administered in intravenous solution.

VI. Hypotensive Anesthesia Contraindication

Hypotensive anesthesia is not suitable for all patients because lowering the blood pressure during surgery can be potentially unsafe in some patients. Patients with cardiac disease, diabetes mellitus, hepatic disease, renal disease, ischemic heart disease, disseminated vascular disease, gross anemia, hemoglobinopathies, polycythemia, hypertension, respiratory insufficiency are contraindicated for hypotensive anesthesia.

VII. Conclusion

Patient who undergo orthognathic surgery are young and fit adults who can tolerate hypotensive anesthesia well without significant damage to vital organs. The advantage of hypotensive anesthesia seem to be; significant reduction in blood loss, bloodless surgical field, conservation of patient blood, reduced need for blood transfusion, and increased speed and accuracy of surgery. The development of various new technology and advancement in anesthesia technique make it possible to lowering blood pressure to the lowest level compatible and keeping the risks of vital organ hypoperfusion and other adverse effects to a minimum. Hypotensive anesthesia is undoubtedly of great value in improving the quality of the surgical field in orthognathic surgery where a large amount of blood loss and consequent blood transfusion are to be expected.

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