

Nitroglycerin hypotensive effect and application in a combined surgery for reconstruction after ipsilateral maxillectomy and orbit evisceration

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Abstract: The oral and maxillofacial region is rich in blood, and it is often difficult to stop bleeding during the operation of maxilla. Nitroglycerin is one of the most commonly used antihypertensive drugs in our hospital. We observed the effect of controlled hypotension in patients with maxillary resection. In group N, the patients had different degrees of tachycardia after using nitroglycerin only. In addition, nitroglycerin has the characteristics of rapid drug resistance. A combined reversed temporal muscle flap and random forehead flap technique was performed successfully to reconstruct the large defect after ipsilateral maxillectomy and orbit evisceration. There were 43 cases used this method during 2014-2016 without large side effects.

Keywords: Nitroglycerin, reversed temporal muscle flap, random forehead flap, reconstruction, orbit evisceration.

INTRODUCTION

In our practice, we found that combined reversed temporal muscle flap and random forehead flap can successfully help us to reconstruct the large defect after ipsilateral maxillectomy and orbit evisceration. The oral and maxillofacial region is rich in blood, and it is often difficult to stop bleeding during the operation of maxilla. Nitroglycerin is one of the most commonly used antihypertensive drugs. This study was designed to investigate the effect of remifentanyl on the controlled hypotension in patients undergoing maxillary resection. Remifentanyl analgesia efficacy strong, because of its rapid onset and in vivo metabolic clearance, continuous infusion of short half-life and constant characteristics, so that the drug has a good controllability. Remifentanyl can cause heart rate and blood pressure drop in a certain dose range. The hypotensive mechanism of remifentanyl has not been fully elucidated and exciting vagus nerve, direct expansion of peripheral vascular smooth muscle and inhibit the sympathetic nervous system, reduce stress reaction, the reduced catecholamine release of substances.

Plastic surgery is a branch of surgery, alias reconstructive surgery or plastic and reconstructive surgery. The scope of treatment primarily involves skin and soft tissue, muscle and bone trauma and diseases, and congenital or acquired tissue or organ defects and deformities (Menderes *et al.*, 2002; Tan *et al.*, 2007). For the transplantation of various autogenous tissues by surgery, allograft, xenograft or other substitutes can be used to repair the tissue defects or deformities caused by various reasons, to improve or restore the function and external shape (Cordeiro *et al.*, 1996; Menon *et al.*, 2003; Abu *et al.*, 2017; Liu *et al.*, 2017). We can initially understand from the above

definition that it is an interdisciplinary subject closely related to and crossed with various clinical subjects, and it is made independent because it is mainly applied to the transplantation of various tissues in terms of therapeutic method and approach (Takahashi *et al.*, 2017). The fundamental principles that must be followed by plastic surgery include aseptic operation and noninvasive technique.

MATERIALS AND METHODS

Research data

A total of 43 combined flaps were used to reconstruct the secondary defects after orbital exenteration and hemimaxillectomy surgeries. The patients ranged from 44 to 69 years old and their mean age was 52.7 years. There were five males and eight females. All the patients main diagnosis were malignant tumors from maxillary which had invaded the orbit. All the Temporal muscle flaps were harvested through a coronal incision and all the skin flaps were designed vertically in the region of lateral forehead with their pedicle located at the lateral side of the outer canthus and tips located at the border of hair line. Careful dissection is made between superficial fascia and the deep fascia to expose the temporal muscle. A small strip of muscle is left attached to temporal bone with periosteal elevator. The muscle is dissected from the coronoid process to the region beneath the zygomatic arch. When the dissection near the zygomatic arch should be carefully to avoiding injury the middle-temporal artery which is a branch of the maxillary artery. Avoiding injury to the facial nerve branches dominating forehead and the temple is also important. The temporal muscle flap is then rotated into the secondary defect after hemimaxillectomy and sutured in layers. The skin flap should also be rotated to the defect secondary orbital exenteration. Drainage is necessary in the process. The incision is closed in layers

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at last. Approved by the ethics committee of the hospital, all patients signed informed consent before surgery.

For plastic surgery, aseptic operation is a principle that must be strictly enforced, since any infection may directly affect surgical outcomes. Moreover, since plastic surgery is complicated to operate and lasts long, and not only is the surgical field relatively broad, but more than two surgical fields may be involved at times, wound exposure and infection may occur more frequently. Especially during tissue transplantation, the transplanted tissue is an ischemic tissue, and bound to become less resistant to infection before the rebuilding of blood circulation. So, aseptic operation must prevail during plastic surgery. All the previous efforts may be wasted once the transplanted tissue is infected, and not only will necrosis be caused in the transplanted tissue, but the recipient area will be destroyed. As a result, the tissue will lose the only opportunity to be reconstructive. Aseptic operation must also prevail when a fresh posttraumatic wound is healed or closed, and the contaminated wound must be cleaned, so that all skin grafts or flaps could survive after transplantation, to ensure the restoration of regional functions. During facial surgery involving nose, eye or oral cavity, absolute asepsis is not easy to implement locally, but preoperative preparation should be made for skin and oral cavity, and any exogenous source of infection shall not be introduced into the surgical field in the surgery process. Aseptic operation relates to every aspect and detail of surgery, requiring that everybody participating in surgery and preparing surgical instruments should first develop a strict aseptic concept, and follow and perform the aseptic operation procedure conscientiously.

Anesthesia and controlled hypotension

All operations were performed by the same group of surgeons. All patients were randomly divided into Nitroglycerin combined with remifentanyl group (NR) and nitroglycerin group (N). All patients were treated with total intravenous anesthesia. 30min before anesthesia intramuscular injection of atropine 0.5mg, phenobarbital sodium 0.1g. The patient was connected to the operation room and monitored. All patients were monitored by radial artery catheterization to monitor the invasive arterial blood pressure, and routine monitoring of ECG, HR, SpO₂ and PETCO₂. Anesthesia induction using midazolam 0.05mg/kg, Propofol 1~1.5m /kg, Fentanyl 2g/kg, Vecuronium 0.1mg/kg, Tracheal intubation mechanical ventilation to control breathing. Nitroglycerin was formulated as 0.01% in normal saline and remifentanyl in normal saline as a solution of 0.002%. Resection of the maxilla began to reduce blood pressure, the starting time by the operator ahead of time 5min inform. Buck target: MAP reduced to 70% of base value (minimum not less than 60mmHg). Observe and record Before anesthesia induction (T0), reaching the target (T1), 5min (T2) after reaching the target, As well as stop

depressurization after 15min (T3) MAP, HR, and record the time to achieve the goal, the amount of transfusion, blood loss, the amount of nitroglycerin per kilogram of body weight.

RESULTS

Statistical analysis results

There was no significant difference in age, sex, body weight, total blood pressure, time of operation, volume of transfusion and blood loss between the two groups. N group of 2 cases, NR group of patients with antihypertensive effect of 1 patients were not satisfied with the use of Pell to complete the buck, excluded from this study. The rest of the patients were completed according to the expected goal, the operation is smooth, safe return to ward. All patients were followed up for 72h after operation. The hemodynamics was stable and no severe complications were found. T1 and T2 in group HR was significantly faster than T0 and NR group, the two groups of MAP was significantly lower than T0 ($P<0.01$) (table 1). NR group to achieve the goal of reducing the time was significantly shorter than the N group ($P<0.05$); NR group nitroglycerin dosage was significantly less than N group ($P<0.05$) (table 2).



Fig. 1: Preoperative photo (anterior view).



Fig. 2: Preoperative photo (oral view)

Case report

In this series, all the 43 muscle flaps and skin flaps are survived without facial nerve branches injury. The majority side effects were slight depressed deformities and redundant deformities beside the pedicle of the skin flap. Nobody expressed the desire to decrease these deformities. A 56-year-old female patient was diagnosed as recurrent squamous cell carcinoma of right maxilla (figs. 1-2). She was first undergone maxillectomy. One year later, the tumor recurred and invaded ipsilateral evisceration of the orbit. After that she was undergone an extended maxillectomy and an orbit evisceration. Due to which a large subcutaneous defect of the right middle face with cutaneous defect of the orbit area of about 2.5cm×5.0cm was formed. (fig. 3).



Fig. 3: A large subcutaneous defect after ipsilateral maxillectomy and orbit evisceration



Fig. 4: Incisions of combined temporal muscle flap and random forehead flap.



Fig. 5: The flap had been rotated.

We designed a semioval incision along the projection line of the border of temporal muscle and designed a random vertical forehead flap of about 2.5cm×6.0cm in size immediate medial to the donor site of the temporal muscle flap. (fig. 4) The total ipsilateral temporal muscle flap was harvested with periosteal elevator and reversed to fill the

defect after the extended maxillectomy, and the orbit cutaneous defect was reconstructed by the vertical forehead flap whose pedicle was lateral to the orbit defect. The temporal muscle flap was fixed to the residual maxilla without free skin graft transplant (figs. 5). After which we put the drain in both the donor site of the temporal muscle flap and the orbit vacancy. We closed the wound and both the temporal muscle flap and the random forehead flap survived (figs. 6-7).



Fig. 6: Postoperative result of the donor site



Fig. 7: The temporal muscle flap and the random forehead flap survived.

Any surgery will damage and destroy tissues to some extent, and every surgical action, such as excessive clamping, extrusion, stretch and dry or overheated wet compressing may damage and destroy innumerable cells, to cause necrosis in one layer of cells or some tissues. These necrotic tissues will become a bacterial culture medium, and may induce an apparent infection or form scar tissues during healing. All surgeons should cultivate the consciousness of tissue protection. From the perspective of histopathology, any soft tissue, blood vessel, nerve or lymph vessel is a viable tissue, which may be destroyed and damaged to some extent in case of any extrusion or tough treatment, to cause secondary necrosis. Fortunately, noninvasive technique can help

Table 1: Comparison of HR and MAP between the two groups at different time points

Index	Group	case	T0	T1	T2	T3
HR	NR Group	23	65.4±7.4	68.2±11.5	63.9±7.2	70.5±8.0
Times/minute	N group	20	66.1±5.3	97.4±9.6	92.6±10.8	74.2±8.6
MAP	NR	23	97.4±16.5	61.3±5.4	60.4±5.4	98.3±13.9
(mm Hg)	NR	20	107.4±17.0	62.1±4.7	62.1±3.2	102.5±17.2

Table 2: Comparison of the amount of nitroglycerin used to reach the target

Group	Case	Time to reach the target (min)	Nitroglycerin dosage ($\mu\text{g}\cdot\text{kg}^{-1}\cdot\text{h}^{-1}$)
NR Group	23	5.3±1.8	1.7±0.4
N group	20	6.1±1.5	1.8±0.3

minimize the damage ratio. Surgeons should perform surgery steadily, accurately, gently and quickly. Scalpel, surgical scissors and suture needle must be sharp and exquisite. Would shouldn't be exposed to air for too long, but should be covered with gauze containing saline water at all times. However, overheated gauze containing saline water shall not be used, especially in the hemostatic process. Usually, there is urgent hope to stop bleeding, so hot gauze is often applied to wound before it cools down, and this inevitably causes damage to wound tissues. The damage will delay wound healing, but it is avoidable.

DISCUSSION

Radical resection of maxillofacial malignant tumor is often necessary to remove the maxilla, where the blood is rich and difficult to stop bleeding. The use of controlled hypotension can reduce bleeding, make the field clear, easy to operate. Because these patients are mostly elderly, the magnitude of controlled hypotension should not be too large. Nitroglycerin due to mild hypotension, less adverse reaction, after stopping blood pressure rise quickly and the expansion of coronary artery, increase myocardial oxygen supply and other benefits, used for controlled hypotension such surgery. However, nitroglycerin can also cause reflex tachycardia, leading to an increase in myocardial oxygen consumption. Group N were treated with nitroglycerin after different degree tachycardia, individual patients heart rate even reached 120 times per minute, led to the obvious increase of myocardial performance, while reducing the myocardial blood perfusion time for elderly patients with acute myocardial ischemia can occur. In addition, nitroglycerin has the characteristics of rapid drug resistance. In the group N patients in the process of reducing blood pressure, only increase the amount of nitroglycerin to maintain a satisfactory level of blood pressure. At the same time, the use of nitroglycerin for a long time, the use of high doses of the risk of occurrence of methemoglobin, resulting in patients with nitroglycerin poisoning.

Remifentanyl analgesia efficacy strong, because of its rapid onset and *in vivo* metabolic clearance, continuous infusion of short half-life and constant characteristics, so

that the drug has a good controllability. Remifentanyl can cause heart rate and blood pressure drop in a certain dose range. The hypotensive mechanism of remifentanyl has not been fully elucidated and exciting vagus nerve, direct expansion of peripheral vascular smooth muscle and inhibit the sympathetic nervous system, reduce stress reaction, the reduced catecholamine release of substances. NR group was treated with remifentanyl intravenous infusion of small doses of nitroglycerin infusion based on pressure drops, heart rate did not significantly accelerate the reflection of heart rate that small dose remifentanyl can counter the nitroglycerin caused faster. Remifentanyl also has the effect of lowering blood pressure, reducing the amount of nitroglycerin, reducing the risk of the use of large doses of nitroglycerin poisoning.

A defect combined with subcutaneous defect after maxillectomy and composite defect after orbit evisceration is rare and complicated. Little has been written about this kind defects. The temporal muscle flap which is versatile and reliable because its robust blood supply have been used to reconstruct mid-face defects for nearly 100 years. In this study, the temporal muscle flaps was used to reconstruct the secondary defects after maxillectomy and orbit evisceration. But the temporal muscle is not enough to fill adequately a combined defect at same time. The reason we used the temporal muscle flap to fill the subcutaneous defect after maxillectomy was that the palate can be reconstructed at the same time. The reversed temporal muscle with or without free skin graft can play the roles of palate very well. If the temporal muscle flaps were used to fill the orbit vacuity, we would have to find the other method for palatal reconstruction. When the temporal muscle flap is used to reconstruct defect after orbit evisceration, the cutaneous defect of orbit region can be covered with free skin graft. In these combined secondary defects, free skin graft can not be used to reconstruct the cutaneous defect without soft tissue filling into the orbit vacuity. Because there was not appropriate recipient site. So it was necessary to design a local flap to cover the orbit defect. A vertical random forehead flap solved this problem after a simple 90°rotation. In most patients, the anterior temporal hairline begins 3-5 centimeter posterior to the lateral

orbital rim. So it is possible for us to harvest a depilous skin flap to cover the orbital defect. and the donor site can be closed directly and easily.

CONCLUSION

Overall, with the simple use of nitroglycerin to control blood pressure, nitroglycerin combined with small dose remifentanil controlled hypotension to reduce the amount of nitroglycerin, reflex inhibition of nitroglycerin induced tachycardia, helps to maintain the stability of circulatory function. But remifentanil has a significant inhibition on myocardial contractility, especially for patients with heart disease before surgery. Therefore, in elderly patients, especially in the use of nitroglycerin, remifentanil still need to select the appropriate pump rate. This combined reversed temporal muscle flap and random forehead flap technique can be used to reconstruct the large defect after simultaneous ipsilateral maxillectomy and orbit evisceration. It is worth being reported and shared.

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