World Journal of Transplantation

Submit a Manuscript: http://www.wjgnet.com/esps/
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
DOI: 10.5500/wjt.v6.i4.646

World J Transplant 2016 December 24; 6(4): 646-649
ISSN 2220-3230 (online)

MINIREVIEWS

Face transplantation: Anesthetic challenges

Aparna Dalal

Aparna Dalal, Department of Anesthesiology, Icahn School of Medicine at Mount Sinai, New York, NY 10029, United States

Author contributions: Dalal A authored the paper.

Conflict-of-interest statement: The author has not received any financial support for this review article, nor has any conflicts of interest to disclose.

Manuscript source: Unsolicited manuscript

Correspondence to: Aparna Dalal, MD, Department of Anesthesiology, Icahn School of Medicine at Mount Sinai, 1428 Madison Ave, New York, NY 10029, United States. dalalanesthesia@gmail.com
Telephone: +1-216-2722545
Fax: +1-646-6853610

Received: February 14, 2016
Peer-review started: February 14, 2016
First decision: March 25, 2016
Revised: August 22, 2016
Accepted: October 17, 2016
Article in press: October 19, 2016
Published online: December 24, 2016

Abstract

Face transplantation is a complex vascular composite allotransplantation (VCA) surgery. It involves multiple types of tissue, such as bone, muscles, blood vessels, nerves to be transferred from the donor to the recipient as one unit. VCAs were added to the definition of organs covered by the Organ Procurement and Transplantation Network Final Rule and National Organ Transplant Act. Prior to harvest of the face from the donor, a tracheostomy is usually performed. The osteotomies and dissection of the midface bony skeleton may involve severe hemorrhagic blood loss often requiring transfusion of blood products. A silicon face mask created from the facial impression is used to reconstruct the face and preserve the donor's dignity. The recipient airway management most commonly used is primary intubation of an existing tracheostoma with a flexometallic endotracheal tube. The recipient surgery usually averages to 19-20 h. Since the face is a very vascular organ, there is usually massive bleeding, both in the dissection phase as well as in the reperfusion phase. Prior to reperfusion, often, after one sided anastomosis of the graft, the contralateral side is allowed to bleed to get rid of the preservation solution and other additives. Intraoperative product replacement should be guided by laboratory values and point of care testing for coagulation and hemostasis. In face transplantation, bolus doses of pressors or pressor infusions have been used intraoperatively in several patients to manage hypotension. This article reviews the anesthetic considerations for management for face transplantation, and some of the perioperative challenges faced.

Key words: Face transplantation; Vascular composite allotransplantation; Organ harvest; Facial reconstruction

Core tip: Face transplantation is a complex vascular composite allotransplantation surgery. During donor harvest, osteotomies and dissection of the midface bony skeleton may involve severe hemorrhagic blood loss often requiring transfusion of blood products. A silicon face mask created from the facial impression is used to reconstruct the face and preserve the donor's dignity. The recipient surgery usually averages to 19-20 h. Since the face is a very vascular organ, there is usually massive bleeding, both in the dissection phase as well as in the reperfusion phase, requiring use of pressors. This article reviews the anesthetic considerations for management

for face transplantation, and some of the perioperative challenges faced.

Dalal A. Face transplantation: Anesthetic challenges. *World J Transplant* 2016; 6(4): 646-649 Available from: URL: http://www.wjgnet.com/2220-3230/full/v6/i4/646.htm DOI: http://dx.doi.org/10.5500/wjt.v6.i4.646

INTRODUCTION

Face transplantation is a complex vascular composite allotransplantation (VCA) surgery. VCA involves multiple types of tissue, such as bone, muscles, blood vessels, nerves to be transferred from the donor to the recipient as one unit[1]. It is a rapidly evolving field which has benefited tremendously from the advances in microsurgery, transplantation, and immunologic techniques. Complex facial defects can be corrected, both functionally and cosmetically. Restoration involves availability of sufficient blood supply, esthetic unit match, nerve function, and integration into the recipients surrounding structures.

The first face transplant was performed in France in 2005[1] and the first near total face transplant was performed in the United States by the Cleveland Clinic Foundation in 2008[2]. Till date (Jan 2016) there have been 37 (20 partial and 17 full face) transplants done in the world. In Europe, face transplants have been done in France, Spain, Belgium, Turkey and Poland. China has been the only Asian Country to venture in this field[3-5]. There have been five patient deaths reported so far[5].

VCAs were added to the definition of organs covered by federal regulation [the Organ Procurement and Transplantation Network (OPTN) Final Rule] and legislation (the National Organ Transplant Act). The designation went into effect on July 3, 2014[6]. The United Network of Organ Sharing (UNOS) was assigned to oversee all face and hand transplants and take responsibility for developing all relevant policies and byelaws in this field. Thus a special VCA Transplantation committee was formed by UNOS in 2014, to develop aspects of VCA policies such as refining allocation policy, defining criteria for VCAs to be covered in OPTN policy, OPTN membership requirement for VCA transplant programs, data requirements, data collection procedures, *etc.*[7].

Face transplantation is a relatively new and rapidly developing field, and experience and expertise in this field is still limited. The American Society of Anesthesiologists (ASA) has not yet developed any guidelines to manage face transplantation procedures. This article reviews the anesthetic considerations for management for face transplantation, and some of the perioperative challenges faced.

ANESTHETIC CONSIDERATIONS

Donor

The ASA Physical Status Classification System typically classifies a declared brain dead patient whose organs are being removed for donor purposes as ASA Ⅵ. Prior to harvest of the face, a tracheostomy is usually performed because endotracheal intubation may hamper the surgical procedure[8]. The donor operation involves removal of the facial segment which varies as per the recipient's requirements[9]. The donor graft may contain skin, multiple vessels, nerves, muscles, and facial bones. The dissection can be very prolonged and may take 12-15 h, even up to 22 h[9,10]. The osteotomies and dissection of the midface bony skeleton may involve severe hemorrhagic blood loss needing transfusion of blood products. Explantation is done after systemic heparinization. The vascular pedicle consisting of carotid and internal jugular vessels is also dissected and used to flush the graft with cold preservative solution such as University of Wisconsin solution[9]. Though the total ischemia time tolerated by facial grafts is unknown, approximately 4 h should be well tolerated[11-13]. A silicon face mask created from the facial impression is used to reconstruct the face and preserve the donor's dignity[8,14].

If the donor is a multiorgan donor, co-ordination with other solid organ teams is vital. If there is elevated blood loss and hemodynamic instability, then the solid organ team should ideally be prepared to harvest the other organs immediately. Otherwise, solid organ retrieval could be delayed till just prior to the face explantation. The solid organs should ideally be given priority over the VCAs[8].

Recipient

The common indications for face transplantation have been devastating facial injuries which not only produce subsequent disfigurement but also compromise key facial functions, such as breathing, eating, facial expressions, vision *etc.*[3]. Though face allotransplantation may not be life saving, it certainly has a significant impact on an individual whose face has been severely injured, and constitutes a major reconstructive procedure[15,16]. It is essential for both, physical and social survival, and optimal social survival makes physical life worth living[15].

The ASA Physical Status Classification System typically classifies patient with end organ stage disease undergoing a transplant surgery as ASA IV, *i.e.,* a patient with systemic disease that is a constant threat to life. However, since a face transplant is not theoretically life saving, the patient may fall into category ASA Ⅲ, *i.e.,* a patient with a severe systemic disease, with substantive functional limitations. However, the patient may have several other comorbidities which may increase the ASA Grade. Reports published so far have cited damage to other organs as well, due to thermal burns, animal attacks, radiation injury, ballistic trauma, electrical burns, lye burns *etc.*[1,3,16].

The airway management most commonly used in facial transplantations has been *via* a primary intubation of an existing tracheostoma with a flexometallic endotracheal tube[17,18]. Primary orotracheal intubation may be challenging in cases of restricted mouth opening,

with facial skin contractures as commonly seen in burns, chemical trauma, *etc*. In such cases, fiberoptic intubation, awake or asleep, depending on the patient airway and the risks of aspiration, can be performed. Prior to commencement of surgery, a tracheostomy is done and a soft flexometallic endotracheal tube is inserted into the trachea. This is then sutured rather than tied, inorder to prevent compression to venous outflow from the face by pressure exerted by the circumferential tie[17,18].

Face transplantation surgery has a very long duration, usually averaging to approximately 19-20 h[17,18]. One case has been reported to have a surgical time of 36 h[19]. Venous access and hemodynamic monitoring would depend on the patient and existing comorbidities. An arterial line allows accurate monitoring of hypotension especially during massive blood loss, and also sampling for hematocrits, blood gases and coagulation profiles. Radial or femoral arterial lines can be placed, depending on accessibility.

A central line is usually preferred to administer fluids and pressors. The internal jugular and subclavian veins may be at risk of thrombosis, or maybe inaccessible. Though femoral venous access is associated with a higher degree of infection[20], it has been used in several cases[17,18]. Whenever feasible, a subclavian central venous line is preferable, to reduce risk of infections in this group of patients receiving immunosuppressive therapy postoperatively. A slight reverse trendenlenberg position (15 degrees) can be used to facilitate venous drainage and reduce blood loss.

Patients are usually induced using an induction agent such as propofol or etomidate, an opioid such as fentanyl or sufentanil, and a muscle relaxant. Muscle relaxants are usually avoided during the course of the procedure during dissection and reconstruction phases involving neural repair. Anesthesia is usually maintained using propofol, opioid, *e.g.,* remifentanil and inhalationals eg. sevoflurane. No particular anesthetic technique has been proven more superior than the other in face transplantation or free flap surgery. Normothermia is usually maintained by appropriate surface warming and by warming intravenous fluids and blood products administered to the patient. A mean arterial pressure of 65 mmHg ensures adequate perfusion and oxygen deliver to the vital organs including the graft. Urine output of 0.5-1 mL/kg per hour is usually adequate. In cases of severe hypotension, apical and subcostal views in transthoracic echocardiography maybe useful in assessing cardiac function. Antibiotics, timely redosing of antibiotics and immunosuppresssants are crucial to the success of this surgery.

Since the face is a very vascular organ, there is usually massive bleeding, both in the dissection phase as well as in the reperfusion phase. Moreover, osteotomy sites can bleed excessively. Anesthesiologists involved in this surgery have reported that quantification of the bleeding is often difficult due to diffuse bleeding into the drapes and poor visualization of surgical site. Prior to reperfusion, often, after one sided anastomosis of the graft, the contralateral side is allowed to bleed to get rid of the preservation solution and other additives which maybe used for allograft preservation, such as heparin or tissue plasminogen activator[18].

A median of 20 U of packed red blood cells, 13 U of FFP, 2 platelet units, and 13 L of crystalloid administration has been reported[18]. Though usually, massive transfusion protocols advocate 1:1:1 replacement of red blood cells, FFP and platelets[21], the amount of plasma and platelets transfused have been on the lower side due to fear of risk of thrombosis of the facial vessels. Intraoperative product replacement should be guided by laboratory values and point of care testing for coagulation and hemostasis such as thromboelastography. Use of colloids such as dextrans[22] are not preferred, and there is no data currently available on use of albumin for this surgery.

Many surgeons usually discourage use of pressors in microsurgical procedures, and though it is not typically a first line strategy, intraoperative use of pressors should be discussed in advance with the surgical team. It has been observed that there has been no difference in the outcomes when pressors were used or not used, and there is no reliable evidence to support contraindication of pressor use[23]. Frequency of flap necrosis and postoperative complications and adverse events were similar with or without use of intraoperative pressors[24]. Norepinephrine has been analysed as the most potential suitable agent for free flap transfer when compared to epinephrine, dobutamine and doxepine. This is because with norepinephrine, control of blood flow depends mostly on low frequency vasomotion or average blood pressure[22,25]. Though vasoconstriction increased, the blood pressure increased too, resulting in overall increased lap blood flow[26]. Dobutamine increases flap skin conductance, thereby benefiting flap blood flow[26]. Epinephrine decreased flap blood flow[26]. In face transplantation, bolus doses of pressors or pressor infusions have been used intraoperatively in several patients to manage hypotension[17,18].

Post procedure, the regular flexometallic endotracheal tube maybe replaced by a regular tracheostomy tube, prior to transfer of the patient to the intensive care unit.

CONCLUSION

Face transplantation is a long procedure and involves complex planning for airway management, vascular access, fluid and pressor management. Teamwork between the surgeon, anesthesiologist and intensivist is essential for a successful outcome.

REFERENCES

1 **Murphy BD**, Zuker RM, Borschel GH. Vascularized composite allotransplantation: an update on medical and surgical progress and remaining challenges. *J Plast Reconstr Aesthet Surg* 2013; **66**: 1449-1455 [PMID: 23867239 DOI: 10.1016/j.bjps.2013.06.037]

2 **Siemionow M**, Papay F, Alam D, Bernard S, Djohan R, Gordon C, Hendrickson M, Lohman R, Eghtesad B, Coffman K, Kodish E,

Paradis C, Avery R, Fung J. Near-total human face transplantation for a severely disfigured patient in the USA. *Lancet* 2009; **374**: 203-209 [PMID: 19608265 DOI: 10.1016/S0140-6736(09)61155-7]
3 **Wo L**, Bueno E, Pomahac B. Facial transplantation: worth the risks? A look at evolution of indications over the last decade. *Curr Opin Organ Transplant* 2015; **20**: 615-620 [PMID: 26536422 DOI: 10.1097/MOT.0000000000000253]
4 **Roche NA**, Blondeel PN, Van Lierde KM, Vermeersch HF. Facial transplantation: history and update. *Acta Chir Belg* 2015; **115**: 99-103 [PMID: 26021941 DOI: 10.1080/00015458.2015.11681077]
5 **Sosin M**, Rodriguez ED. The Face Transplantation Update: 2016. *Plast Reconstr Surg* 2016; **137**: 1841-1850 [PMID: 27219239 DOI: 10.1097/PRS.0000000000002149]
6 Organ Procurement and Transplantation Network Final Rule. Available from: URL: https://optn.transplant.hrsa.gov/governance/about-the-optn/final-rule/
7 United Network of Organ Sharing. Available from: URL: http://www.transplantpro.org
8 **Rahmel A**. Vascularized Composite Allografts: Procurement, Allocation, and Implementation. *Curr Transplant Rep* 2014; **1**: 173-182 [PMID: 25927020]
9 **Brazio PS**, Barth RN, Bojovic B, Dorafshar AH, Garcia JP, Brown EN, Bartlett ST, Rodriguez ED. Algorithm for total face and multiorgan procurement from a brain-dead donor. *Am J Transplant* 2013; **13**: 2743-2749 [PMID: 23915309 DOI: 10.1111/ajt.12382]
10 **Bueno J**, Barret JP, Serracanta J, Arnó A, Collado JM, Valles C, Colominas MJ, Diez Y, Pont T, Salamero P, Martinez-Ibañez V. Logistics and strategy of multiorgan procurement involving total face allograft. *Am J Transplant* 2011; **11**: 1091-1097 [PMID: 21443675 DOI: 10.1111/j.1600-6143.2011]
11 **Pomahac B**, Papay F, Bueno EM, Bernard S, Diaz-Siso JR, Siemionow M. Donor facial composite allograft recovery operation: Cleveland and Boston experiences. *Plast Reconstr Surg* 2012; **129**: 461e-467e [PMID: 22373994 DOI: 10.1097/PRS.0b013e31824129d7]
12 **Lanzetta M**, Petruzzo P, Dubernard JM, Margreiter R, Schuind F, Breidenbach W, Nolli R, Schneeberger S, van Holder C, Gorantla VS, Pei G, Zhao J, Zhang X. Second report (1998-2006) of the International Registry of Hand and Composite Tissue Transplantation. *Transpl Immunol* 2007; **18**: 1-6 [PMID: 17584595 DOI: 10.1016/j.trim.2007.03.002]
13 **Villamaria CY**, Rasmussen TE, Spencer JR, Patel S, Davis MR. Microvascular porcine model for the optimization of vascularized composite tissue transplantation. *J Surg Res* 2012; **178**: 452-459 [PMID: 22651980 DOI: 10.1016/j.jss.2012.03.051]
14 **Datta N**, Yersiz H, Kaldas F, Azari K. Procurement strategies for combined multiorgan and composite tissues for transplantation. *Curr Opin Organ Transplant* 2015; **20**: 121-126 [PMID: 25856175 DOI: 10.1097/MOT.0000000000000172]
15 **Siemionow M**, Sonmez E. Face as an organ. *Ann Plast Surg* 2008; **61**: 345-352 [PMID: 18724140 DOI: 10.1097/SAP.0b013e3181844ea3]
16 **Janis JE**, Khansa I, Lehrman CR, Orgill DP, Pomahac B. Reconstructive Management of Devastating Electrical Injuries to the Face. *Plast Reconstr Surg* 2015; **136**: 839-847 [PMID: 26090762 DOI: 10.1097/PRS.0000000000001619]
17 **Sedaghati-nia A**, Gilton A, Liger C, Binhas M, Cook F, Ait-Mammar B, Scherrer E, Hivelin M, Lantieri L, Marty J, Plaud B. Anaesthesia and intensive care management of face transplantation. *Br J Anaesth* 2013; **111**: 600-606 [PMID: 23704190 DOI: 10.1093/bja/aet159]
18 **Edrich T**, Cywinski JB, Colomina MJ, Jiménez López I, Xiong L, Sedaghati A, Pomahac B, Gilton A. Perioperative management of face transplantation: a survey. *Anesth Analg* 2012; **115**: 668-670 [PMID: 22523417 DOI: 10.1213/ANE.0b013e3182554493]
19 **Smith-Spark L**, CNN. Transplant recipient meets sister of man who gave him a new face. Available from: URL: http://edition.cnn.com/2015/05/29/health/face-transplant-sister-encounter/index.html
20 **Latif A**, Halim MS, Pronovost PJ. Eliminating Infections in the ICU: CLABSI. *Curr Infect Dis Rep* 2015; **17**: 491 [PMID: 26031963 DOI: 10.1007/s11908-015-0491-8]
21 **Ho AM**, Holcomb JB, Ng CS, Zamora JE, Karmakar MK, Dion PW. The traditional vs "1: 1: 1" approach debate on massive transfusion in trauma should not be treated as a dichotomy. *Am J Emerg Med* 2015; **33**: 1501-1504 [PMID: 26184524 DOI: 10.1016/j.ajem.2015.06.065]
22 **Motakef S**, Mountziaris PM, Ismail IK, Agag RL, Patel A. Emerging paradigms in perioperative management for microsurgical free tissue transfer: review of the literature and evidence-based guidelines. *Plast Reconstr Surg* 2015; **135**: 290-299 [PMID: 25539313 DOI: 10.1097/PRS.0000000000000839]
23 **Ibrahim AM**, Kim PS, Rabie AN, Lee BT, Lin SJ. Vasopressors and reconstructive flap perfusion: a review of the literature comparing the effects of various pharmacologic agents. *Ann Plast Surg* 2014; **73**: 245-248 [PMID: 23851374 DOI: 10.1097/SAP.0b013e31828d0b3]
24 **Kelly DA**, Reynolds M, Crantford C, Pestana IA. Impact of intraoperative vasopressor use in free tissue transfer for head, neck, and extremity reconstruction. *Ann Plast Surg* 2014; **72**: S135-S138 [PMID: 24691344 DOI: 10.1097/SAP.0000000000000076]
25 **Eley KA**, Young JD, Watt-Smith SR. Power spectral analysis of the effects of epinephrine, norepinephrine, dobutamine and dopexamine on microcirculation following free tissue transfer. *Microsurgery* 2013; **33**: 275-281 [PMID: 23362174 DOI: 10.1002/micr.22072]
26 **Eley KA**, Young JD, Watt-Smith SR. Epinephrine, norepinephrine, dobutamine, and dopexamine effects on free flap skin blood flow. *Plast Reconstr Surg* 2012; **130**: 564-570 [PMID: 22929242 DOI: 10.1097/PRS.0b013e31825dbf73]

P- Reviewer: Barker JH, Janis JE, Petruzzo P **S- Editor**: Kong JX
L- Editor: A **E- Editor**: Lu YJ

Published by **Baishideng Publishing Group Inc**
8226 Regency Drive, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com