

Review Article

Anaesthetic complications in plastic surgery

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ABSTRACT

Anaesthesia related complications in plastic surgeries are fortunately rare, but potentially catastrophic. Maintaining patient safety in the operating room is a major concern of anaesthesiologists, surgeons, hospitals and surgical facilities. Circumventing preventable complications is essential and pressure to avoid these complications in cosmetic surgery is increasing. Key aspects of patient safety in the operating room are outlined, including patient positioning, airway management and issues related to some specific conditions, essential for minimizing post-operative morbidity. Risks associated with extremes of age in the plastic surgery population, may be minimised by a better understanding of the physiologic changes as well as the pre-operative and post-operative considerations in caring for this special group of patients. An understanding of the anaesthesiologist's concerns during paediatric plastic surgical procedures can facilitate the coordination of efforts between the multiple services involved in the care of these children. Finally, the reader will have a better understanding of the perioperative care of unique populations including the morbidly obese and the elderly. Attention to detail in these aspects of patient safety can help avoid unnecessary complication and significantly improve the patients' experience and surgical outcome.

KEY WORDS

Anaesthesia; complications; plastic; surgery

INTRODUCTION

Plastic surgeries are often associated by the common man with cosmetic surgeries. As a result, there is an inherent unwillingness to bear even minimal risk. Moreover, plastic surgeries in today's times are far more than just cosmetic surgeries. All surgeries carry risk and plastic/cosmetic surgery is no exception; however

additional factors pertaining to plastic surgeries may aggravate the existing comorbid conditions. Patients posted for the plastic surgeries often present complex and difficult scenarios to the anaesthesiologists to handle. For the sake of discussion, we have classified these case scenarios as:

- Those inherent to the age of the patients in which these conditions appear:
 - Infants, for congenital defects such as cleft palate, cleft lip
 - Geriatric population for blepharoplasty, face lift, etc.
- Those with medical comorbidities involved, e.g., surgeries for obese patients (liposuction), paraplegics, diabetics (decubitus ulcers, gangrene, amputations) and burns patients (contracture release, skin grafting, reconstruction)

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- Conditions that pose difficulties in airway management because of the primary disease (temporomandibular joint ankylosis, submucosal fibrosis, post-burns contracture involving neck and face, facial fractures).

COMPLICATIONS INHERENT TO THE AGE OF THE PATIENTS IN WHICH THESE CONDITIONS APPEAR

Paediatric patients

Many of the paediatric patients posted for plastic surgery make repeated visits to the operation room so the anxiety component may be very high, which has to be dealt with compassion.

Difficulty in ventilation and intubation are often encountered in patients coming for surgeries like cleft lip and palate, craniosynostosis. Many associations and syndromes have been described.^[1] Difficulties in airway management may occur during induction of anaesthesia or in the immediate post-operative period.^[2] In a review of perioperative airway complications following pharyngeal flap palatoplasty, Peña *et al.* reported incidence of 10% airway complications in the 88 patients studied.^[3] The presence of other associated craniofacial anomalies has been associated with a significantly increased difficulty in airway management and risk of airway obstruction.^[4,5]

For these patients, intravenous access may be established before induction of anaesthesia. Use of straight laryngoscope blade, lateral or molar approach, external laryngeal manipulation and a piece of rolled gauge

packed in the cleft palate defect may help.^[6] Fibreoptic bronchoscope, Bullard laryngoscope and laryngeal mask are other alternatives for securing the airway.^[7]

Inadvertent extubation is a possibility in case of orofacial and craniofacial reconstructive surgeries, like cleft palate, where surgeon and anaesthesiologist share the airway. Extension of the neck may pull the endotracheal tube (ETT) out and flexion may make the ETT endobronchial. The ETT needs to be secured meticulously with application of benzoin or mastisol. Alternatively, the surgeon may place a suture around the ETT. The gag used in opening the mouth in cleft palate repair may occlude the ETT or push it into the right bronchus. So, it is important to auscultate the chest after application of the mouth gag and attention should be paid to the airway pressure to exclude occlusion of ETT.

In case of prolonged surgery, hypothermia and pressure effects on the bony prominences are common. Both of these complications are more common in children and elderly patients. Preventions and complications of hypothermia are enumerated in Table 1. For the later problem, all pressure points are carefully padded. Hyperextension of joints is prevented by placing soft rolls to keep the joints in slightly flexed position.

In surgeries like those for craniosynostosis; major blood loss and fluid shift are common. Attention to fluid homeostasis is necessary to maintain adequate perfusion to the tissues and also to prevent air embolism (AE) through the open venous sinusoids. Blood loss is difficult

Table 1: Complications of hypothermia and its prevention

Patient group	Complications	Preventions	Remarks
Adults	Immediate		
	Inhibits tissue oxygen delivery	Pre-warming the operation theatre	Pre-anaesthesia
	Cardiac dysrhythmias	Pre-warming the patients with forced air warmer for one hour prior to the onset of possible hypothermia	Pre-anaesthesia
	Coagulopathies, difficulty in haemostasis and increased risk of bleeding related complications	Warming of all fluids (intra venous fluids, wetting solutions, local anaesthetic solutions)	Intra-operative
	Oliguria	Use of low flow anaesthesia and humidifier in the breathing circuit	
	Worsening of electrolyte imbalance	Use of warming blanket and warming mattress	
	Post-operative shivering leads to increased oxygen requirement and possible cardiac ischemia	Wrapping the exposed parts	Anaesthesia technique
Paediatric specific	Delayed		
	Post-operative wound infection		
	Delay in wound healing		
	Delayed recovery	Placing of child on heated pad Wrapping the head surface in addition to other body parts	Head surface area of paediatric patients is proportionally more

to measure as it is generally accumulated in drapes. Serial haematocrit estimation combined with child's intravascular volume status should guide transfusion. It has been found that haematocrits as low as 20-22% is good enough for adequate oxygen transportation to the tissues.^[8] Antifibrinolytic such as tranexamic acid infusion have been used in recent years to reduce blood loss.

Nearly, 19% of the patients undergoing paediatric craniofacial surgery may have abnormal coagulation due to several reasons.^[9] Ongoing blood loss may consume coagulation factors. Fluid administration may cause dilutional coagulopathy. Tissue thromboplastin is released by surgical manipulation. Any one or combination of these may cause coagulation problems. Various blood factors like fresh frozen plasma and cryoprecipitate are transfused, guided by laboratory tests such as prothrombin time, activated thromboplastin time and fibrinogen levels.

Airway obstruction and laryngospasm are common after orofacial surgeries, especially in children. This can be suspected by observing the intercostal and subcostal retractions with no air flow. If so, the possible causes may be a blood clot, retained throat pack, airway narrowing or tongue swelling from retraction. Active management will depend upon the cause. On completion of the surgery, oropharynx has to be inspected to remove the throat pack and blood clot, if any. The child is extubated when fully awake and close observation is continued during recovery.

Emergence delirium (ED) occurs in 20-80% of children, especially when sevoflurane is used for maintenance of anaesthesia.^[10] A study by Kain *et al.* suggested that children with ED are 7 times more likely to develop behavioural changes.^[11] Various techniques including administration of propofol, ketamine and lidocaine has been described to reduce ED.

Elderly plastic surgery patients

Elderly patients are at greater risk for perioperative complications because of combined effects of reduced organ functions and prevalence of age related concomitant diseases. Life expectancy has increased because of improved health-care and the elderly population are more aware of their health and wants to look good. This has led more geriatric patients coming for cosmetic procedures such as facelift, blepharoplasty and liposuction.

The risk associated with the plastic surgery and anaesthesia in this age group can be minimised by better understanding of physiologic changes. They are more prone to heat loss and shivering because of reduced basal metabolic rate, impaired thermoregulation and heat production. Drug metabolism and excretion are slower because of the increased proportion of body lipid, dehydration and reduced renal and liver functions. These make them more susceptible to drug related toxicity. They are also more likely to suffer cardiac and pulmonary complications.

The incidence of post-operative delirium in the elderly population is almost 10%. The causes may be multifactorial and include patients' age, baseline low cognitive function, dementia, depression, low visual and auditory functions.^[12] Other causes may include sleep deprivation, unfamiliar environment and post-operative pain. Delirium is associated with increased duration of hospital stay and poorer functional recovery.

THOSE BECAUSE OF THE MEDICAL CO-MORBIDITIES INVOLVED

Obesity

Liposuction is the most common surgery obese patients subject themselves to. The possible complications associated with liposuction can vary from mild to severe, including death.^[15] The choice of anaesthesia in liposuction depends upon the patient's preference, anaesthesiologist and surgeon preference, area and duration of the procedure. Initial liposuction without any wetting solution led to increased blood loss.^[14] Wetting solution is a mixture of fluid, epinephrine and lignocaine in various concentrations. So, if used in excess may lead to lignocaine toxicity. If the patients receives general anaesthesia, lignocaine component can be reduced further or eliminated without a post-operative sequel of increased pain.^[15] The possible complications are:

- Local anaesthetic toxicity: Although very low concentrations are used, lidocaine and adrenaline may result in toxicity. Lidocaine toxicity has neurological and cardiac effects.^[13] The first signs of toxicity being circumoral numbness, tinnitus and light-headedness in conscious patients. Increasing levels cause tremors, seizures and eventual cardiac and respiratory arrest. In patients under anaesthesia, arrhythmias may be the only sign.^[16] Blood levels of lignocaine ranging from 35 mcg/kg^[17] to 55 mcg/kg^[18] were found to be safe. Peak levels of lidocaine and its active metabolite

monoethylglycinexylidide occur within 8-32 h after initial infiltration.^[15] Adrenaline has been shown to have increased cardiovascular effects after infiltration and peaks at 5 h after infiltration. Patients with limited cardiac reserve are at higher risk of developing these cardiovascular side-effects. The causes of deaths reported following liposuction had been cardiac arrest due to fluid overload, pulmonary oedema, lignocaine toxicity, fat embolism and acute respiratory distress syndrome.^[19]

- Volume overload: Tumescence liposuction has been implicated in volume overload and pulmonary oedema.
- Hypothermia: Hypothermia is quite common in liposuction. It is defined as the core body temp less than 36°C. Risk and gravity of hypothermia is more with larger volume of liposuction. The prevention and possible complications are enumerated in Table 1.
- Deep venous thrombosis (DVT) and pulmonary embolism (PE): Incidence of DVT in liposuction had been reported at less than 1%, but there is a marked increase in incidence of DVT when liposuction is combined with other surgeries, like abdominoplasty. It is believed that all patients undergoing liposuction surgery experience a thromboembolic shower due to fat particles being dislodged during surgery resulting in pulmonary fat embolism syndrome.^[20] Abdominoplasty has the highest published rates of DVT and PE in plastic surgery. Reasons include long duration of surgery and post-operative inactivity.^[21] There is impaired drainage of the deep veins of the legs and pelvic area because of flexion at the hip. PE is the single largest cause of mortality in patients receiving liposuction. The frequency of DVT and PE in patients undergoing large volume liposuction ranges between 0% and 1.1%. In one survey of board-certified plastic surgeons, PE was found to be the leading cause of death following liposuction, accounting for 23% of all deaths. In a prospective series of office based surgical procedures, 63.6% of post-operative deaths in those that survived surgery were secondary to thromboembolism.

Mechanical prophylaxis includes gradual compression stockings and venous foot pumps. Low molecular weight heparins have the advantage of selectively inhibiting factor XA and IIA. There is reluctance of plastic surgeons to use chemoprophylaxis because of the fear of bleeding, but there is little to no increase frequency of bleeding if these drugs are used appropriately.

High risk patients are those with age more than 40 years, duration of surgery more than 30 min,

additional risk factors such as malignancy, immobilization, obesity, hypercoagulable states.^[21] In these patients chemoprophylaxis with low molecular weight heparin (e.g., enoxaparin) is strongly indicated.

- Other complications include acute blood loss and post-operative nausea and vomiting (PONV).^[15]

PONV is a major concern after general anaesthesia. Use of narcotics and nitrous oxide aggravates the problem. Serotonergic antagonists, ondansetron (2-4 mg i.v.) and granisetron (0.2-1 mg i.v.) and dexamethasone (4-8 mg) are useful for prophylaxis. Combination therapy using multiple anti-emetics is advisable for patients at high risk for PONV-young women, non-smokers and those with a history of PONV.^[22]

Burns-acute

Recent trends in acute deep burns are early excision and wound coverage of the burnt area. The risk of this approach is the physiological insult of surgery to a patient who was in any case deteriorating rapidly from their initial injuries. Monitoring can be a challenge in major cases when access to chest (ECG), arms (arterial pressure) and digits (pulse oximetry) can be limited. Skin staples or subcutaneous needles attached to crocodile clips can be used for ECG monitoring.^[23] An arterial line and a cardiac output monitor is essential for major excisions as blood loss can be significant.

- Succinylcholine should be avoided for muscle relaxation in major burns (more than 10% of total body surface area) if more than 24 h old. It leads to hyperkalaemia and possibly, cardiac arrest. There might be resistance to non-depolarising muscle relaxants (e.g., pancuronium, vecuronium etc.,) and a higher dose might be required
- Thermal injuries to the upper airway (above larynx) may result in significant swelling of the pharynx and the epiglottis, rendering laryngoscopy and intubation difficult or even impossible. Presence of stridor, hoarseness and swollen uvula should alert the anaesthesiologist of the possibility^[23]
- There may also be injury to the lower airways (below larynx). It may cause the airway's epithelium to swell, increased mucus secretion, inflammation, atelectasis and airway obstruction. Bronchoscopy may reveal carbonaceous deposits, oedema, bronchial and mucosal erythema, haemorrhage and ulceration^[23]
- Hypothermia is a common risk. Patients lose heat by radiation, conduction and convection/evaporation. Body thermostat is raised by 0.03°C/percentage of

body surface area burns. Precautions to prevent hypothermia are mentioned in Table 1

- There is the risk of large blood loss with dilution of the clotting factors. Adequate replacement should be performed on a war footing.

Decubitus ulcers

Patients are frequently paraplegic or hemiplegic. They have multiple comorbidities such as hypertension, diabetes, coronary artery disease, anaemia and poor nutrition (hypoalbuminemia). Surgeries commonly performed are debridement and flap cover; both these surgeries are associated with significant blood loss, hypothermia, cognitive dysfunction and complications associated with prone positions.

Prone position can be associated with multiple complications. The most common are injuries to central nervous system, injuries to peripheral nerves (ulnar neuropathy), direct pressure injuries (to ears, breasts, genitalia and other dependent areas) and peripheral vessel occlusion (compression and occlusion of peripheral vessels such as axillary artery and radial artery). Post-operative visual loss had also been reported with incidence of 0.0008%.^[24] It is advisable to maintain neutral neck position to minimise the risk of occluding the carotid or vertebral arteries and internal jugular veins. Excessive neck flexion may lead to overstretching of cervical cord. One should be careful with the padding of all the bony prominences and positioning of the arms.^[24]

Microvascular free flap surgery

- Inadvertent hypothermia is common as mentioned before and has wide ranging ramifications [Table 1]
- Fluid loss - One should replace fluid deficit as a result of fasting, insensitve losses (perspiration and urine) with isotonic crystalloid and blood and plasma losses with warmed colloid and then with blood. Viscosity plays a relatively greater role than vessel radius in determining blood flow in the flap microcirculation. Hence, normovolaemic haemodilution is tolerated as the optimal haematocrit is kept at approximately 30-35%, with minimum haemoglobin of 7-8 g%^[25]
- Emergence and extubation should be smooth. Coughing and retching increase venous pressure, compromising the flap perfusion^[25]
- One should avoid shivering post-operatively and treat it aggressively with active warming. Oxygen saturation should be maintained above 95%.

CONDITIONS THAT POSE DIFFICULTIES IN AIRWAY MANAGEMENT

The difficulty in managing airway may be in the form of difficulty in bag mask ventilation, difficulty in endotracheal intubation or both.

The most common conditions where difficulty in airway management can be expected are, cleft lip and palate repair, maxillofacial trauma, post burn contracture of neck and face, temporomandibular joint ankylosis and patients with submucosal fibrosis. Anaesthesia for cleft lip and palate surgery is discussed elsewhere.

Maxillofacial trauma and reconstruction

Maxillofacial trauma very frequently presents difficulty in airway management. These can be avoided by carefully timing the surgery, so that tissue oedema subsides, but malunion of facial bones does not occur. Fracture of the base of skull traditionally precludes nasal intubation, but Bahr and Stoll in a study of 160 patients reported that the route of intubation did not affect the rates of post-operative complications.^[26]

Maxillofacial reconstruction is often required to correct the effects of trauma (e.g., Le Fort fractures) and developmental malformations, for obstructive sleep apnoea, radical cancer surgeries (e.g., mandibulectomy) and orthognathic procedures (e.g., Le Fort osteotomies, mandibular osteotomies). These share many of the same surgical and anaesthetic problems and techniques.

Pre-operative airway evaluation must be detailed and thorough. Particular attention should be focused on jaw opening, mask fit, neck mobility, micrognathia, retrognathia, maxillary protrusion (overbite), macroglossia, dental pathology, nasal patency and the existence of any intraoral lesions or debris. Patients with facial trauma may have blood, foreign bodies, hematoma, lost or broken teeth, dentures, bony fragments, displaced bone, vomit, tongue injuries and tissue oedema. Presence of active haemorrhage may pose difficulty in fiberoptic laryngoscopy. One must ensure effective suction and have available a variety of laryngoscope blades and ETT. It is advisable to perform rapid sequence induction.^[27] If there are any anticipated signs of problems with mask ventilation or tracheal intubation, the airway should be secured prior to induction. This may involve fiberoptic nasal intubation, fiberoptic oral intubation or tracheostomy. Nasal intubation with a

Ring-Adair-Elwyn (RAE) preformed tube or a straight tube with a flexible angle connector is usually preferred in dental and oral surgery. Submental intubation may also be used to secure the airway. It involves passing the ETT through a surgical incision in the floor of the mouth. Often, an armoured tube is used as the ETT takes an acute turn^[27] and it prevents kinking. The pros and cons of each of the three techniques for securing the airway - tracheostomy, nasal intubation with fibrescopy and submental intubation are listed in Table 2.

There is a likelihood of serious intraoperative airway problems such as tracheal tube kinking, disconnection or perforation by a surgical instrument. Airway monitoring of end-tidal CO₂, peak inspiratory pressures and oesophageal stethoscope breath sounds assumes increased importance in such cases.

Chronic burns

Circumoral burns and burns on the neck pose special problems regarding airway management for the anaesthesiologist. Releasing the neck scar under ketamine while maintaining spontaneous ventilation to aid subsequent intubation^[28] as well as, the intubating laryngeal mask airway, oesophageal tracheal CombitubeTM and retrograde wire technique, have all been used successfully in intubating burn patients.^[29,30]

Temporomandibular joint ankylosis and submucosal fibrosis result in restricted mouth opening leading to difficulty in performing direct laryngoscopy and intubation. Intubation by fiberoptic bronchoscopy should be planned.

The first step in avoiding difficulties in airway management is proper assessment of the airway, before administering general anaesthesia to any patient and especially those

for surgery of the head and neck. The history includes a review of available previous anaesthesia records, direct questioning of the patient and in those with reduced consciousness, a search for any records about previous airway difficulty. A history of previous airway difficulty has a higher positive predictive value and lower negative predictive value than any tests.^[31] However, a history of previous easy laryngoscopy does not guarantee straightforward intubation in as much as increased age or pathology may result in increased difficulty.

Limited mandibular protrusion, abnormal neck anatomy, sleep apnoea, snoring and obesity are independent predictors of moderate or severe difficulty with mask ventilation. Snoring and a thyromental distance of less than 6 cm are independent predictors of severe difficulty.^[32] "Bones" is a good mnemonic to remember predictors for difficult mask ventilation, where 'B' stands for the presence of beard, 'O' for obesity, 'N' for no teeth, 'E' for elderly and 'S' for history of snoring.

However, there is no single predictor for accurately predicting difficult mask ventilation as the incidence of difficult bag mask ventilation is as low as 0.07%.^[31] The combination of mouth opening, jaw protrusion and head extension is the core of airway assessment. Four principles are central to prevention of complications during tracheal intubation:^[33]

- Maintenance of oxygenation takes priority over all other issues
- Trauma must be prevented. The number of attempts with blind techniques should ideally be zero and certainly not more than four
- When unanticipated difficulty occurs in non-lifesaving surgery, the safest plan is to terminate attempts at tracheal intubation, awaken the patient and postpone surgery

Table 2: The pros and cons of different techniques of securing the airway in facillomaxial surgeries

Tracheostomy		Nasal intubation with fibrescopy		Submental intubation	
Pros	Cons	Pros	Cons	Pros	Cons
Avoids controversial nasal route	Most invasive of the three techniques	Allows intra-operative IMF	Requires the expertise of fibrescopy	Allows intra-operative IMF	Not good for prolonged post-operative ventilation and weaning
Allows pre-operative IMF	Extra procedure	Avoids an extra surgical procedure	Poor for prolonged post-operative ventilation and weaning	Low complication rate	
Better for a long time ventilation	Risks of haemorrhage, tracheal damage, stenosis, tracheomalacia and infection	Avoids surgical scar	There should be nasal blockade	Cosmetically acceptable scar	
			Risks of nasal haemorrhage, sinusitis		

IMF: Inter-maxillary fixation

- “Call for help” as soon as difficulty with tracheal intubation is experienced
- Immediate confirmation of correct tracheal tube placement is an essential and integral part of tracheal intubation. Several tests should be used because no single test is completely reliable. The most important safeguard is clinical suspicion.^[33]

Head and neck surgery

Establishing, maintaining and protecting an airway in the face of abnormal anatomy and simultaneous surgical intervention can test the skills and patience of any anaesthesiologist.

Surgery for cancer of the head and neck includes laryngectomy, glossectomy, pharyngectomy, parotidectomy, hemimandibulectomy and radical neck dissection. Need for tracheostomy depends on the patient's pre-operative airway compromise. Some procedures may include reconstructive surgery, such as the transplantation of a free microvascular muscle flap.

The typical patient presenting for head and neck cancer surgery is elderly and has a long history of heavy tobacco and alcohol use. Pre-existing medical conditions that often need pre-operative evaluation and optimisation include chronic obstructive pulmonary disease, coronary artery disease, chronic alcoholism, aspiration pneumonia and malnutrition.

Airway management may be complicated by an obstructing lesion or pre-operative radiation therapy that has further distorted the patient's anatomy. If there is serious doubt regarding potential airway problems, an intravenous induction should be avoided in favour of awake direct or fiberoptic laryngoscopy (cooperative patient) or an inhalational induction, maintaining spontaneous ventilation (uncooperative patient). In any case, the equipment and personnel required for an emergency tracheostomy must be immediately available. Elective tracheostomy under local anaesthesia is a prudent option, particularly if indirect laryngoscopy shows that the lesion is susceptible to dislodgment during intubation.

Manipulation of the carotid sinus and stellate ganglion during radical neck dissection (the right side more than the left) has been associated with wide swings in blood pressure, bradycardia, arrhythmias, sinus arrest and prolonged QT intervals. Infiltration of the carotid

sheath with local anaesthetic will usually ameliorate these problems. Bilateral neck dissection may result in post-operative hypertension and loss of hypoxic drive because of denervation of the carotid sinuses and bodies.

Slipping of the inferior portion of the jugular vein may lead to AE. AE may be related to inadvertent suction of air into the venous system. Clinical signs of AE include a sudden drop in blood pressure, cardiac output and oxygen saturation. Nitrous oxide should be stopped and the patient ventilated with 100% oxygen. The patient should be positioned in the left lateral decubitus position so that the air can be trapped in the right atrium. Aspiration of the air embolus may be attempted through the central venous catheter, if already in place.

At the end of surgery, the oropharyngeal pack must be removed and the pharynx should be suctioned. Although it is not unusual for there to be some bloody debris during initial suctioning, repeat efforts should be less productive. If there is a chance of post-operative oedema involving structures that could potentially obstruct the airway (e.g., tongue), the patient should be carefully observed and perhaps should be left intubated for the first overnight period. Also, haemodynamically unstable and drowsy patients with poor reflexes should be considered for elective ventilation. Otherwise, extubation can be attempted once the patient is fully awake and there are no signs of continued bleeding. Patients with inter-maxillary fixation (e.g., maxillomandibular wiring) should have appropriate cutting tools at their bedside in case of vomiting or other airway emergencies.^[27]

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