Clinical Advances in Head & Neck Surgery

Chapter 2

# Anaesthesia for Head and Neck Cancer Surgery

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## 1. Introduction

The incidence of head and neck cancers is on the rise. This implies that the anaesthesiologists will be dealing with these patients more often, in both elective and emergency operation theatres for various diagnostic, therapeutic and palliative procedures. Head and neck cancers (HNC) are most commonly associated with tobacco use [1] in various forms. This also has concurrent anaesthetic implications. Most of these patients would also be candidates for chemo-and/or radio-therapy, which also poses several anaesthetic challenges. The over-riding concern in anaesthesia for HNC patients is the safe management of the airway. A proper structured plan for airway management needs to be laid down for every patient, at every step: during intubation, during intra-operative surgical manipulations and at the time of extubation. This requires a multi-disciplinary approach and a sound understanding between the onco- surgeon, anaesthesiologist, plastic surgeon and the intensivist. Most of these patients may have associated co-morbid conditions, which warrants pre-operative optimization and suitable modification of the anaesthetic management. Nutritional and psychological considerations need special mention in all HNC patients.

## 2. Background

There is a growing concern that the nature of peri-operative anaesthetic management can influence the post-operative outcomes and cancer recurrence in onco-surgeries [2]. With HNC showing a rising trend, there have been tremendous advancements in treatment of these

patients, which has opened newer challenges for the anaesthesiologist. In addition, robotic surgery for HNC is being done routinely at many centres for minimally-invasive surgery of such cancers. This chapter has been written with the intent of highlighting the anaesthetic considerations in patients presenting with HNC. The explanation of the entire gamut of HNC is beyond the scope of this chapter and hence the salient anaesthesiologic points are discussed.

## 3. Head and Neck Cancer Surgery

A detailed discussion of the types of cancer and their respective surgeries is beyond the scope of this chapter. The basic types of cancer affecting the head and neck region [3] include the following: Squamous cell carcinoma; Basal Cell Carcinoma; Malignant Melanoma and Lymphomas. The following table (**Table 1**) summarises the surgeries (radical and reconstructive) undertaken for HNC along with their possible airway management options (*abbreviation "Ca" signifies 'carcinoma'*):

**Table 1**

| Diagnosis | Radical Surgical Resection | Reconstructive Surgery | Airway Management |
|---|---|---|---|
| Ca Buccal Mucosa | Commando+ Radical neck Dissection | Local mucosal rotation flap | Nasal tube |
| Ca Tongue | Partial glossectomy+ Supra omohyoid neck dissection; Tongue Commando; TORS (trans-oral robotic surgery for deep seated tumours) | Radial artery free flap (RAFF)/ Antero lateral thigh free flap (ALT-FF) reconstruction | Naso-tracheal intubation For reconstructive free flap, IV Line and radial artery on right side/ dorsalis pedis in RAFF In ALT-FF, Spare right lower limb for the surgeon/flap harvest. |
| Ca Maxilla | Commando; Maxillectomy with plate fixation | Pectoralis major myocutaneous flap (PMMC); Nasolabial flap; RAFF | Nasal tube; Oral south pole tube |
| Ca Mandible | Segmental Mandibulectomy; Total mandibulectomy | PMMC flap; Free fibular flap | Nasal tube; North pole tube; Flexo-metallic tube. In free fibula flap, spare the lower limb opposite to the side of head and neck lesion for plastic surgery |
| Ca Paranasal sinuses | WLE (wide local excision) | | Oral flexo-metallic tube with throat packing |
| Ca Thyroid | Right/ Left Hemithyroidectomy Or Total thyroidectomy | Reconstruction Usually not required; PMMC flap if trachea is breached | Flexo-metallic tube to pass beyond the site of obstruction; Awake FOB (fibre-optic bronchoscopy) intubation in retrosternal goitre or tracheal infiltration with tumour; Monitor for signs of facial nerve palsy |
| Ca Para thyroid | Parathyroidectomy | Reconstruction not required | Monitor for hypocalcaemia |

| | | | |
|---|---|---|---|
| Ca parotid and other salivary glands | Total parotidectomy | | Monitor for signs of facial nerve palsy |
| Ca Nasopharynx | WLE + lymph node dissection + Radiotherapy | | Oral flexo-metallic tube |
| Ca Hypopharynx | WLE + lymph node dissection; TORS | | Oral flexo-metallic tube |
| Ca Larynx | LASER excision of vocal cord nodule;<br>Micro-laryngeal surgery (MLS);<br>Total laryngectomy | | Video-laryngoscope guided intubation;<br>Tracheostomy;<br>MLS TUBE;<br>LASER tubes;<br>J-tube |
| Ca lip/tip of nose/ forehead/ facial integument | Wide local excision | Forehead rotational flap;<br>Nasolabial flap | Oral tube |
| Ca scalp | Wide local excision | | Oral tube |
| Occult primary | Neck dissection for occult primary | | Flexo-metallic tube |

## 4. Preoperative Evaluation

A thorough pre-anaesthetic evaluation or check-up (PAC) is the corner stone of any successful anaesthetic management of onco-surgery. A complete physical examination, appropriate investigations, assessment of the extent of tumour, considerations for concurrent radio-and/or chemotherapy and a discussion of the plan of airway and pain management forms the core of PAC. Optimization of any pre-existing co-morbidities is of paramount importance. Counselling regarding smoking cessation, which has a strong association with HNC, can be started in the PAC clinic [4]. The emotional trauma associated with facial disfigurement can be difficult to treat. A visit to the dietician, psychologist or psychiatrist and the physiotherapist can be requested depending upon the current status of the patient for ensuring a better peri-operative course.

The following points need to be looked-into while performing a PAC of a patient scheduled for HNC surgery:

**A. Airway examination*:*** Patients presenting for HNC surgery tend to have difficult airways more often. The difficulty could be in mask ventilation, laryngoscopy or both. The surgical access may be impeded by the presence of a certain airway device and this needs to be discussed preoperatively with the surgeons. The patient needs to be explained about awake intubation possibility. There may also be requirement for tube retention post-operatively. Some patients may require preoperative tracheostomy for airway-threatening growths [5]. All airway distances (thyromental, hyo-mental, sterno-mental, inter-incisor, and mandibular distances) need

to be measured for accurately predicting the presence of a difficult airway. In addition, LEMON [6] (Look, Evaluate the 3-3-2 rule, Mallampatti grading, Obstructive signs and Neck examination) assessment can be followed for emergency airway evaluation. Position of trachea, hoarseness of voice, stridor or noisy breathing, subcutaneous emphysema and nasal patency needs to be examined specifically in these patients.

**B. General physical examination:** A thorough head-to-toe examination of the patient must be done to check for vital parameters, pallor, icterus, anasarca, pedal oedema, ascites, raised JVP (jugular venous pressure), generalised lymphadenopathy, metastatic deposits, weight, BMI (body mass index) and spinal tenderness. A systemic examination of the chest, abdomen and central nervous system needs to be done. Metastatic work-up must be done as the common sites of metastasis from HNC include lungs, lymph nodes, spine, brain and liver [7].

**C. Investigations:** Routine PAC investigations need to be done for all patients. This includes a complete hemogram, electrocardiogram (ECG), chest X-ray, liver function tests, renal function tests and serum electrolytes. Blood sugar levels must be monitored and controlled preoperatively in diabetic patients. Protein and albumin levels may be reduced in case of liver involvement and as a consequence of malnutrition. Hypoalbuminemia [8] may lead to generalised oedema or ascites. This may alter the dosing and requirements of anaesthetic agents by interfering with protein binding of drugs.Coagulation profile may be done in patients with altered liver functions, jaundice or pre-existing coagulopathies. Blood grouping and cross-matching must be done in all HNC patients, as they may require perioperative blood transfusions. Some of these patients may have reduced platelet counts following chemotherapy-induced bone marrow suppression or drug-reactions. Blood and blood- products must be arranged for all onco-surgeries.

**D. Cardiac evaluation:** A two-dimensional echocardiography can be requested in patients with pre-existing cardiac diseases, poor functional class patients, ECG changes suggestive of myocardial ischemia, cardiomyopathy or cardiac failure patients. In patients with poor cardiopulmonary exercise testing and in those who have taken chemotherapy with Adriamycin analogues [9], echocardiography should be done. A stress test (dobutamine or exercise or thallium stress test) can be done in high-risk patients susceptible to peri-operative myocardial ischemia. These patients are prone to develop peri-operative arrhythmias, myocardial ischaemia and thromboembolism.

**E. Smoking cessation:** Most patients presenting for HNC surgery have history of tobacco use. Smoking has several anaesthetic implications, including nicotine-induced sympathetic nervous system stimulation, diminished muco-ciliary action and reactive airway disease changes. Submucous fibrosis [10] can also lead to difficult airway. Anaesthesiologists can serve as excellent counsellors to quit smoking, starting at the PAC clinic. Smoking cessation, even for a

brief period has positive effects during the perioperative period. The following table highlights the benefits [11] of smoking cessation according to the preoperative time interval:

- 12 hours: reduced carboxy-haemoglobin levels, reduces arrythmogenic effects
- 24 hours: reduces elevated heart rate and blood pressure
- 1 week: improves raised blood viscosity and polycythaemia
- 1 month: improves small airway function
- 6 weeks: reduces excess sputum production
- 2 – 6 months: reduces risk of postoperative chest infection

**F. Evaluation for the effects of concurrent chemo-and/or radiotherapy:** Patients with HNC may have preoperative radiotherapy to the affected site or of the neck to reduce the vascularity and size of the tumour. This leads to local fibrosis and the tissues of the neck and oro-pharynx become rigid and unyielding. It can lead to difficult laryngoscopy and difficulty in intubation [12] or even, fibreoptic bronchoscopy. It can lead to increased bleeding and difficulty in dissecting the planes during surgery, causing prolonged anaesthesia time and increased transfusion requirements, with its attendant risks. Wound healing may be delayed in radiotherapy-treated areas. Chemotherapy has a multitude of systemic effects like bone marrow depression, immunosuppression, hepatic or renal function derangement, cardiomyopathy (Adriamycin analogues), lung oxygen toxicity (Bleomycin analogues) [13], bone pain and increased susceptibility to infections.

## 5. Intraoperative Care and Postoperative Considerations

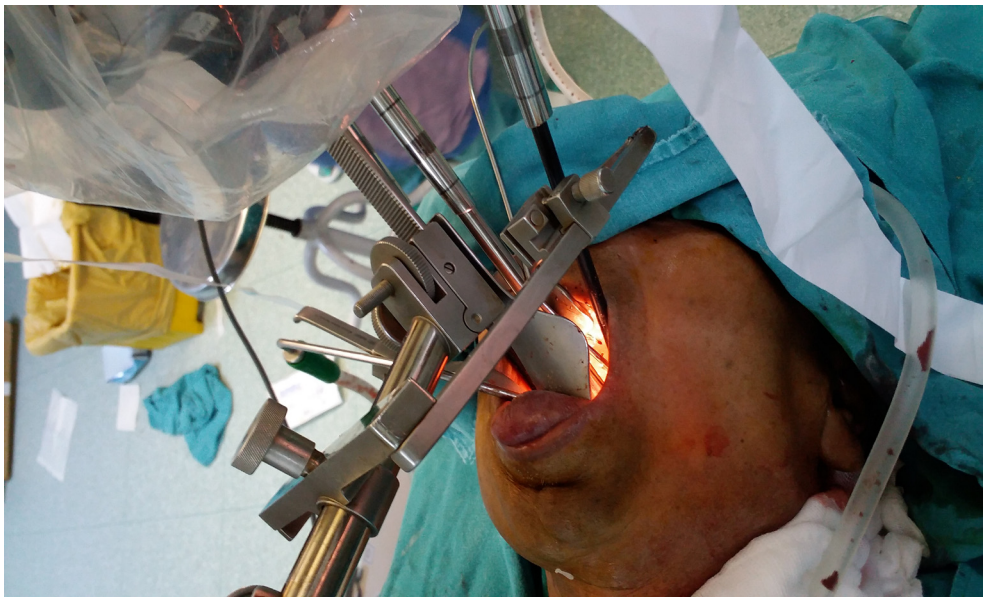
Generally, general anaesthesia is administered to all patients with controlled ventilation, along with all difficult airway precautions and preparations, including awake fibreoptic intubation and preoperative tracheostomy. Standard monitoring in the form of pulse oximetry, heart rate, non-invasive blood pressure, temperature, electrocardiogram and end-tidal carbon-dioxide (capnography) must be followed for every case. In addition, invasive monitoring [14] in the form invasive arterial blood pressure, central venous pressure and urine output monitoring needs to be instituted in patients with co-existing systemic diseases and in complicated, long-duration radical or reconstructive surgeries. Other monitors which are used in HNC onco-surgeries include peripheral nerve stimulator for neuromuscular monitoring, BIS (bi-spectral index) monitor for depth of anaesthesia and cardiac output monitors. Two large-bore intravenous catheters must be inserted on either arms or hands. These surgeries can sometimes can be associated with torrential haemorrhage [15]. In addition, the fibrosis caused by radiotherapy or previous surgery can lead to difficulty in dissecting the surgical planes

and blood loss. Hence, blood and blood products must be arranged preoperatively. The main anaesthetic goals include maintenance of normoxia, normocarbia, normotension and normothermia. Positioning injuries and compression of the neuro-vascular bundles must be avoided by proper padding and cushioning of pressure points of the body, especially during robotic surgery in susceptible individuals [16]. Special attention must be given to securing the airway during surgery as there are chances of tube displacement or dislodgement or transection [17], which can be catastrophic. Particular attention must be given for the counting and removal of the throat packs [18] (If any) postoperatively, inserted at the beginning of surgery. External heating blankets and other suitable measures must be undertaken in all patients to prevent the development of hypothermia. Postoperative care depends on whether patient is extubated and hemodynamically stable at the end of the surgery. Care of the airway, monitoring lines and vascular catheters is of paramount importance. Post-operative nausea vomiting (PONV) prophylaxis is mandatory. The usual postoperative complications include wound haematoma, bleeding into drain, massive neck swelling, airway oedema, failure of vascular graft take-up, thromboembolism, sepsis/wound infection, prolonged intubation or mechanical ventilation, hemodynamic instability requiring inotropic support, blood transfusion risks, renal shut-down, development of arrhythmias, fluid and electrolyte imbalances, myocardial ischaemia and impaired nutrition.

## 6. Robotic Head and Neck Cancer Surgery [TORS]

Trans-oral robotic surgery is a recent addition to the field of minimally invasive surgery. The daVinci ™ robotic system (Intuitive Surgical, Sunnyvale, California, USA) is utilized to reach difficult to reach areas of oral cavity (**Figure 1**). Its purported advantages include less blood loss, improved cosmesis, better view of difficult-to-reach lesions, minimal pain and early postoperative recovery [19]. Its indications have been extended to radical tonsillectomy, partial laryngectomy, glossectomy and complex intra-oral lesion excision. All the instruments

**Figure 1**



have seven degrees of freedom with “endo-wrist” technology. Drawbacks of robotic surgery [20] relate to issues of cost, lack of tactile feedback and over-reliance on the patient side surgeon. Widespread adoption by more high-volume centres across the globe will help mitigate the costs.

The operating table may need to be turned such that the robotic arms come over the head-end, the vision tower is positioned on one side of the patient and the anaesthesia machine is on the foot-end of the table. This means that the breathing circuit needs to be longer and consideration must be given for the resultant increase in dead space (by adjusting the ventilatory parameters). The detection of ETCO2 (end-tidal carbon dioxide) may also be delayed through a conventional carbon-dioxide analyser. This is of special importance in detection of intra-operative air embolism or circuit disconnections. Extension lines must be applied to intravenous catheters as the patients’ hands may be positioned away from the anaesthesiologist. The entire robotic surgery team must be well-versed in quick de-docking of the robot in emergency situations [21]. Neck extension, which is applied for insertion of robotic instruments, may need to be limited in patients with cervical spine deformities. Some patients undergoing TORS may need a preoperative tracheostomy, whose patency needs to be checked before anaesthesia induction. In contrast to open radical surgeries, the nasogastric tube (for gastric decompression and postoperative nutrition) must be inserted only after complete excision of the tumour mass and frozen section clearance of the margins. The use of C-MAC TM video-laryngoscope [22] can greatly help in nasogastric tube insertion and in visualizing any residual tumour growths after TORS.

In TORS, airway handling occurs not only during intubation, but also during assembly of the robot and during the actual surgery. Muscle relaxant infusion under neuromuscular monitoring is required to maintain adequate surgical relaxation and prevent even slight patient movement during robotic surgery. The major cardiovascular changes associated with insertion of the mouth gag and robotic arms include tachycardia, hypertension and increase in systemic vascular resistance [23]. Intra-operative hemodynamic stability can be maintained with either Esmolol boluses [ultra-short acting beta-1 blocker] or NTG (nitroglycerin) or Labetolol [combined alpha and beta blocker] infusion. Uncontrolled hypertension can lead to bleeding, cardiac, cerebrovascular and renal complications. Patients with co-existing cardiovascular diseases require special care during such surgeries. Postoperatively, the patients are usually reversed, but not extubated, in anticipation of airway oedema following intra-oral surgery. Flexo-metallic tube may be changed to *aportex* (PVC or polyvinylchloride) cuffed endotracheal tube (ETT) with the help of a tube exchanger device before reversing neuromuscular blockade. All patients must preferably be monitored in a dedicated onco-surgical intensive care unit with the naso-tracheal tube in-situ.

## 7. Difficult Airway (DA)

Surgery for HNC involves sharing of the airway between the surgeon and the anaesthesiologist. Placement of mask itself may be difficult in fungating tumours and in lip cancers. Mask ventilation can prove to be difficult in large intra-oral and tongue tumours. Some patients with friable posterior pharyngeal wall and laryngeal cancers may require preoperative elective or emergency tracheostomy. Radiotherapy to the head and neck can lead to difficult laryngoscopy and intubation. A fully functional difficult airway cart must be prepared and kept ready for all cases. Airway management for HNC surgery and TORS can be challenging in view of the nature or extent of the cancerous growth and the possibility of airway obstruction. All preparations for DA management must be ensured preoperatively, including adequate nostril preparation for nasal intubation, availability of fibreoptic bronchoscope, video-laryngoscope, cricothyroidotomy and tracheostomy sets. The C-MAC™ video-laryngoscope [24] serves as an excellent tool for securing the airway in these situations, as the cancerous lesion can also be visualized well. Spontaneous respiration should preferably be maintained till the insertion of a definitive airway and muscle relaxant must be given only after confirming correct tube placement. Standard difficult airway guidelines need to be followed with pre-induction formulation of alternative airway management options if the initial plan fails, is the cornerstone of success. A supraglottic airway device may not be an option in certain tumours due to difficulty in insertion and in obtaining an adequate fit. Emergency, invasive airway equipment must be available. A flexo-metallic tube may be preferable to prevent kinking during neck manipulations and intra-oral surgical instrumentation. A radio-opaque oral packing may be done around the endotracheal tube to minimise blood and secretion tricking into the lungs. Awake FOB-guided nasal intubation [25] can be employed in patients with limited mouth opening and trismus. This requires local anaesthetic airway blocks (superior laryngeal nerve block, trans-tracheal block and glossopharyngeal nerve block) as well as good patient cooperation. “Say-Go” technique can also be utilized during insertion of fibre-optic bronchoscope [26] for anesthetizing the airway. Extreme caution must be exercised while intubating patients with friable or pedunculated tumours. Difficult intubation signifies difficulty in extubation as well. Airway device should only be removed after subsidence of airway oedema, preferably over a tube-exchanger device [27]. Hence, many patients may require a brief period of postoperative tube retention or mechanical ventilation after HNC surgery.

## 8. Pain Management

Postoperative analgesia is usually multi-modal, with intravenous paracetamol, NSAID`s (non-steroidal anti-inflammatory agents) and Fentanyl infusion (30-40 mcg/hour) for the first 12 to 24 hours. Alternatively, IVPCA (intravenous patient controlled analgesia) [28] can be utilized for better patient comfort. Ultrasound-guided mental block and superficial cervical plexus block can be supplemented in patients with extensive neck dissections. In patients tak-

ing oral morphine preoperatively for cancer pain, their total 24-hour dosage should be calculated and supplemented by equivalent intravenous morphine postoperatively [29].

Head and neck cancer surgery may result in several pain-producing factors at successive stages as tabulated below:

- Mal-positioning on the operating table
- Infiltration, ulceration or pressure on tissue due to tumour
- Intraoperative nerve and muscle damage
- Pain related to extensive tissue resection
- Psychosocial dimension of pain due to cosmetic disfigurement
- Radiotherapy and chemotherapy induced oral mucositis
- Infection or coexisting morbidity

Preventive and curative measures to manage acute post-operative pain include the following:

- Avoiding hyperextension of head and neck
- Sparing nerve and muscle structures during surgery as far as possible to curb painful sequelae.
- Patient controlled analgesia (PCA) using infusion pumps to deliver morphine for early postoperative pain at tumour resection and flap harvesting sites.
- Physical therapy after flap harvesting to minimize painful sequelae.
- Proper nutrition, adequate sleep and physical activity

The WHO (world health organisation analgesic ladder) [30] recommends the usage of the oral route unless contra-indicated. HNC patients can be administered drugs enterally by nasogastric or gastrostomy tubes or rectal administration. When this is not possible, subcutaneous/ intravenous route or transdermal patches maybe employed.

## 9. Conclusion

Improvements in surgical technology pose various patient safety concerns and newer challenges for the anaesthesiologists. More radical the surgery, greater are the perioperative considerations. Head and neck cancer surgery is unique in that the airway is shared between the surgeon and the anaesthesiologist. Importantly, there are greater chances of encountering a difficult airway, which must be anticipated and requires preoperative formulation of airway management plans. The risk of venous air embolism in such surgeries must also be kept in mind. Trans-oral robotic surgery is a promising technique with numerous advantages and requires several anaesthetic modifications. A thorough preoperative evaluation, meticulous airway management both during intubation-extubation, and maintaining high-patient safety protocols in the perioperative period are the pillars of success. A multidisciplinary approach,

with close liaison between the anaesthesiologist, onco-surgeon, plastic surgeon, intensivist, dietician, psychologist and physiotherapist is the need of the hour in head and neck cancer surgery.

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