Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care

Nishkarsh Gupta
Rohini Dattatri
Vinod Kumar
Sushma Bhatnagar
Editors

Springer

Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care

Nishkarsh Gupta • Rohini Dattatri
Vinod Kumar • Sushma Bhatnagar
Editors

Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care

Springer

Editors
Nishkarsh Gupta
Department of Onco-anaesthesia &
Palliative Medicine, Dr BRA IRCH
All India Institute of Medical Sciences
New Delhi, Delhi, India

Vinod Kumar
Department of Anaesthesiology
University of Minnesota Medical School
Minneapolis, MN, USA

Rohini Dattatri
Department of Anaesthesia
Kasturba Medical College
Manipal, Karnataka, India

Sushma Bhatnagar
Department of Onco-anesthesia &
Palliative Medicine, Dr BRA IRCH
All India Institute of Medical Sciences
New Delhi, Delhi, India

ISBN 978-981-99-6338-6 ISBN 978-981-99-6339-3 (eBook)
https://doi.org/10.1007/978-981-99-6339-3

Foreword

It is a pleasure and honour to write a foreword for the book entitled *Problem Based Learning Discussions in Onco-Anaesthesia and Onco-Critical Care* edited by Nishkarsh Gupta, Rohini Dattatri, Vinod Kumar and Sushma Bhatnagar.

In my 30 years of professional experience in the field of academic surgical oncology, I always felt the need for a dedicated sub-specialty of onco-anaesthesia exclusively dealing with patients undergoing cancer surgery. Patients undergoing onco-surgery have unique challenges due to host and tumour interactions affecting multiple organ systems. Cancer-associated cachexia, sarcopenia, chemotherapy-associated systemic affects cancer-associated metabolic and immunological derangements can profoundly influence intraoperative and postoperative outcomes of cancer patients and can also affect survival outcomes. A significant number of cancer surgeries are complex, challenging, long duration and need to be done on priority basis. Knowledge, experience and skills of anaesthesiologists are extremely important in managing complex cancer surgeries which can influence outcomes. Difficult intubations for advanced head and neck cancers, one lung ventilation for thoracic surgical patients, perioperative management of patients undergoing complex surgical procedures like CRS and HIPEC, microvascular reconstruction, major hepato-pancreatico-biliary resections are few examples highlighting the need for dedicated onco-anaesthesia services. In addition, anaesthesiologist also plays an important role in pain management and critical care. The perioperative care should focus on early return to the intended oncological therapy (RIOT). Recent research has shown that oncological outcomes could be affected based on pharmacological agents used and type of anaesthesia. There is a need for collaborative research between onco-surgeons and onco-anaesthesia fraternity to explore the complex interactions of anaesthesia and surgery on cancer outcomes.

This book provides a comprehensive insight into various domains of onco-anaesthesia field including preoperative assessment, pre-habilitation, perioperative challenges specific to procedure, fluid management, anaesthetic techniques, perioperative pain management, post-operative complications and oncological emergencies. I strongly feel that this book will be of immense value to anaesthesiologists pursuing a career in onco-anaesthesia and also to general anaesthesiologists handling cancer cases.

The team of authors led by Prof. Sushma Bhatnagar are pioneers in this field, and I was fortunate to be professionally associated with them and witness the establishment and growth of a new medical specialty "Onco-Anaesthesia". I wish them all the success and sincerely hope that they will achieve their professional objectives through this book.

Department of Surgical Oncology
BRA-IRCH and NCI, AIIMS,
New Delhi, India

Svs Deo

Contents

About the Editors

Nishkarsh Gupta (MD, DNB, MNAMS, PGCCHM, Fellowship in Palliative Medicine) is working as a Professor in the department of Onco-Anaesthesiology and Palliative Medicine at DR BRA IRCH, All India Institute of Medical Sciences, New Delhi. He is alumnus of Maulana Azad Medical College and a gold medallist. He is assistant editor of *Indian journal of Anaesthesia*, Section Editor *Indian Journal of Palliative Care* and on editorial board panel of various journal. He is the chief editor of the first SA edition of *Clinical Anesthesia by Barash* and *Understanding Anesthesia Equipment by Dorsh and Dorsh*. He is also an editor of five more books. He has numerous national and international publications in various reputed journals (more than 200) and authored several book chapters. He received *MK Dey Award*-2022 by Indian College of Anesthesiologists at Chandigarh. He also received 'Best Researcher Award' in 2021 by ISA, Varanasi and 'Best Reviewer Award' in ISACON, Ahmedabad apart from several other awards in the past. He is an instructor of various skill-based training programmes and has been faculty in several national and international conferences. He is involved in many research projects funded by AIIMS and national agencies like ICMR.

Rohini Dattatri MD, DM (Onco-anaesthesia) is working as Assistant Professor in the department of anaesthesiology, KMC Manipal. She completed her MD (Anaesthesia) from Karnataka Institute of Medical Sciences, Hubli and DM (Onco-anaesthesia) from IRCH, AIIMS, New Delhi. She has an avid interest in research and has publications national and international journals. She has many chapters to her credit as an author and co-author. It includes clinical anaesthesia by Barash (South Asian edition), understanding anaesthesia equipment by Dorsh and Dorsh (South Asia edition), critical care—bench to bedside, onco-critical care—an evidence-based approach, a complete guide to onco-anaesthesia, critical care and cancer pain. She is a good orator and bagged prizes in ISACON Guwahati, ISACON Shillong and YUVA ISACON.

Vinod Kumar is Professor in the department of onco-anaesthesia and palliative medicine at Dr BRA IRCH, All India Institute of Medical Sciences (AIIMS), New Delhi, India. He received his training in anaesthesia from PGIMER, Chandigarh, India. Dr Kumar has a teaching experience of 12 years and guides MD (Palliative medicine) and DM (Onco-anaesthesiology) resi-

dents for research. He has many publications in peer-reviewed national and international journals to his credit and has edited book on onco-critical care by Springer. Dr. Kumar is a reviewer for various national and international journals. He is a member of national anaesthesia, airway and palliative care societies. He is an invited faculty for various national and international conferences.

Sushma Bhatnagar (MD-Anaesthesiology and MSc in Palliative Medicine from Cardiff University, UK) is Chief, Dr BRA IRCH and Head, National Cancer Institute (NCI)-Jhajjar and Professor and Head, Department of Onco-Anaesthesia and Palliative Medicine, Dr BRA IRCH, AIIMS, New Delhi. She has teaching and research experience more than 30 years. She can be described as a real catalyst driving innovation in the medical field by *working towards development of the field of Pain and Palliative Care in India and the developing world*. At AIIMS New Delhi, she developed a *protocol to make 'Pain free AIIMS' and formulated the 'End of Life Care Policy'* to manage pain and distressing symptoms in patients *with a motto of pain-free dignity of life till the end.* She has started two courses at AIIMS, New Delhi - *MD, Palliative Medicine* and *DM, Onco-Anaesthesia*. She is also the Chief Coordinator of Cancer Treatment Centre Programme jointly organized by Lien Collaborative, Singapore, Asia Pacific Hospice Network, Singapore and AIIMS, New Delhi. She is president of Indian Association of Palliative Care. She is editor of books *Textbook of Oncoanesthesiology* (Springer) and *Freedom from Pain* (IK International House Pvt. Ltd., New Delhi). She has been involved in many research projects funded by ICMR, DRDO, Ayush ministry, etc. She has more than 300 publications in national and international journals. She was the chairperson of clinical services of COVID task force at NCI, Jhajjar, AIIMS, New Delhi during COVID-19 pandemic. She is advisory Member of International Association for the Study of Pain (IASP) Press Editorial Board.

1 Carcinoma Buccal Mucosa with Trismus Posted for Hemimandibulectomy and Free Flap Reconstruction

Riniki Sarma, Nishkarsh Gupta, and Anju Gupta

1.1 Introduction

Head and neck cancer includes cancers originating from mouth, nose, sinuses, and throat. They account for nine million new cases and four million deaths annually. The male:female ratio ranges from 2:1 to 4:1. In India the male incidence rate is 20 per 100,000. Mouth and tongue cancer are common in Indian males [1]. Smoking has been implicated as one of the major risk factor associated with head and neck cancers. Apart from that, tobacco chewing for long duration is also associated with squamous cell carcinoma of head and neck [2]. Other risk factors include alcohol, human papilloma virus (especially HPV 16 and squamous cell carcinoma of larynx), occupational exposure with nickel, lead and wood workers, diet rich in salted cured fish, etc. [3]. Carcinoma buccal mucosa is a common oral cancer in India due to widespread use of tobacco products. Most patients present at a later stage when the tumour growth starts hindering quality of life [4]. Treatment of choice in patients with oral cancer is surgery [5]. Presence of oral tumours poses significant threat to airway management that ranges from difficult mouth opening, decreased range of neck movement, loss of anatomical margins, etc. Concomitant use of radiotherapy further may lead to trismus, difficult mask ventilation, and even front of neck access [6]. Thus a multi-disciplinary approach with discussion among the onco-surgeons, plastic surgeon and anaesthesiologists about the proper steps of airway management plan is necessary.

Q. Why Preoperative Assessment in Carcinoma Buccal Mucosa Patients Is Important? How Is It Different from Other Cancer Patients?

1.2 Preoperative Assessment

Apart from cancer, these patients also may have a number of comorbidities as mostly they are aged [7]. So, the plan of anaesthesia should also take the comorbid conditions (COPD, hypertension, diabetes, coronary artery disease, etc.) as well as the age of the patient into consideration. Optimisation of the comorbid conditions should be done before taking the patient for surgery. Carcinoma buccal mucosa may also lead to poor dietary intake in these patients. Hence, nutritional optimisation is of paramount importance. Considerations for previous chemotherapy and radiotherapy should be given. During primary pre-anaesthetic check-up, a thorough physical examination, routine investigations and airway examination should be done. The airway anatomy may change at the time the patient

R. Sarma
Department of Anesthesiology, Pain and Critical Care, JPNATC, AIIMS, New Delhi, New Delhi, India

N. Gupta
Department of Onco-Anesthesiology and Palliative Medicine, DRBRAIRCH, AIIMS, New Delhi, New Delhi, India

A. Gupta (✉)
Department of Anesthesiology, Pain Medicine and Critical Care, AIIMS, New Delhi, New Delhi, India

N. Gupta et al. (eds.), *Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care*, https://doi.org/10.1007/978-981-99-6339-3_1

is scheduled for surgery and so plan of airway management should be discussed. Counselling regarding smoking cessation is to be started from the day of primary PAC. The patient should be counselled regarding postoperative facial disfigurement. Most of the patients present with increased anxiety and nervousness due to the nature of surgery; premedication is to be advised accordingly. Elderly patients with impending compromise of the airway should be given titrated dose of sedative premedications.

1.2.1 Implications of RT CT

Chemotherapy or radiotherapy exposure as part of treatment management is to be elicited as it may alter anaesthesia management. Although surgery is the primary mode of treatment in carcinoma buccal mucosa, radiotherapy is used either as postoperative adjuvant treatment or as definitive treatment in advanced cases with or without chemotherapy. Chemotherapy can be neo-adjuvant, adjuvant or palliative. Radiation results in oedema of the tissues followed by fibrosis or necrosis of that area. There can be pain due to radiation-induced mucositis. Lose teeth or missing teeth, purulent discharge from tumour site or orocutaneous fistula may render mask ventilation and laryngoscopy difficult. Fibrosis resulting in trismus, limited mouth opening or restriction of neck movements makes laryngoscopy and intubation difficult. Post-radiation epiglottic and glottic oedema makes visualisation of vocal cords difficult. Osteoradionecrosis of the jaw is a fatal complication of high-dose radiotherapy seen in 0.4–50% of patients [8]. It can cause reduction in mandibular space and alteration of morphometric measurements leading to difficult airway [9]. Apart from this, radiotherapy is associated with restrictive cardiomyopathy due to myo- and endocardial fibrosis. This is often dose-dependent.

Chemotherapy is mostly given to enhance response to radiotherapy. Commonly used chemotherapy agents are cisplatin, flurouracil, carboplatin, paclitaxel, methotrexate, etc. Bone marrow suppression caused by paclitaxel, docetaxel and methotrexate can lead to thrombocytopenia and neutropenia. Pulmonary toxicity due to paclitaxel or carboplatin can result in noncardiogenic pulmonary oedema, chronic pneumonitis, fibrosis and hypersensitivity pneumonitis [10]. Patients may present with cough, dyspnoea, low-grade fever with bibasal crepitus on examination. Chest X-ray may show ground glass opacities or consolidation. Pulmonary function tests may show decreased diffusion capacity for CO_2, total lung capacity and forced vital capacity. Anthracyclines are associated with dysrhythmias, decreased cardiac contractility and cardiomyopathy. Busulfan results in endocardial fibrosis. Cyclophosphamide causes myocardial tissue injury and doxorubicin results in prolonged QT interval. Clinically, the patient will present with arrhythmias, chest pain, congestive cardiac failure and signs of pericarditis [11]. Methotrexate causes diarrhoea, oral mucositis electrolyte imbalance and weight loss. Drugs like cisplatin and doxetacel are associated with CNS (central nervous system) toxicity.

1.3 Preoperative Investigations

All routine blood tests along with chest X-ray and ECG should be asked prior to surgery. Electrolyte abnormalities may be present in patients with carcinoma buccal mucosa with poor nutritional status. Head and neck cancer is also associated with hypercalcemia [12]. Liver function tests are essential to find out the effect of chemotherapy as well as nutritional status (serum albumin). Radiological investigations have gained prominence in predicting difficult airway management although no single parameter exists. Lateral view of soft tissue of the neck in X-rays can predict difficult airway. CT scan of the airway is more precise than X-rays and can evaluate airway narrowing and deviation of trachea. CT bronchoscopy and virtual bronchoscopy can reconstruct images comparable to real bronchoscopy. MRI can locate tracheobronchial invasion or compression by tumours and assist in airway planning. 3D printing can be used for simulating the patient's airway. It is a comparatively new technology and has only been used for complex airway management cases. Ultrasound of the airway is the most explored radiological entity and can provide real-time assessment [13–15].

1.4 Preoperative Nutritional Optimisation

Patients with carcinoma buccal mucosa suffer from nutritional deficiency not only due to cancer per se but the location of tumour results in poor oral intake as well as painful swallowing. Heavy smoking and drinking further contributes to additional barrier to good nutrition. Unintentional weight loss of >5–10% over 6 months and BMI <20 kg/m^2 is defined as malnutrition in head and neck cancer patients [16, 17]. Subjective global assessment of nutrition and more recently Nutritional Risk Score 2002 (NRS 2002) are used as screening tools in carcinoma buccal mucosa patients. Dietary counselling focuses on maintaining appropriate nutritional intake in patients undergoing chemoradiotherapy. European Society for Parenteral and Enteral Nutrition (ESPEN) and the American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines recommend that ambulating patients with cancer receive 1.2–2 g/kg/day of protein and 30–35 kcal/kg/day of energy daily [18, 19]. It was found that patients maintaining this dietary intake had a better quality of life without the need for additional nutritional intervention [20]. Carcinoma buccal mucosa patients with chronic malnutrition with swallowing impairment and inadequate oral intake may need feeding tube placement. Prophylactic gastrostomy although advocated in some centres is not of much benefit [21]. Also the principle of carbohydrate loading preoperatively is followed in patients with carcinoma buccal mucosa. ERAS guidelines recommend 800 mL of 12.5% carbohydrate drink on the night before surgery and 400 mL on the morning of procedure [22, 23].

Q. How Will You Proceed to Manage the Airway in Such Cases? What Will Be Your Strategy in Case of Trismus?

1.5 Intraoperative Management

1.5.1 The Shared Airway

Clear communication is required between the operating team and anaesthetists. Securing the airway and maintaining it is challenging in the light of abnormal anatomy due to tumour as well as surgical exploration of the area. The surgeon requires complete access to the airway, without any disruption by presence of bulky equipments. Hence the anaesthetist is away from the head end and accessing the airway during emergency may become problematic. In patients undergoing repeated surgery, the anatomy may be distorted requiring extensive redissection and longer duration of surgery. All major society guidelines for difficult airway management emphasise on the use of a preplanned strategy for managing the airway with closed communication between anaesthetists and surgeons [24–26]. Prior consent from the patient should always be taken. At the same time, patients should be explained about the chances of failure of the planned procedure (plan A) and the need to fall back to rescue options (plan B, plan C, etc.).

Awake fibreoptic intubation is the plan of choice for most anaesthesiologists as it ensures that airway is not lost totally. But the preparation of the airway is of vital importance for awake intubation. DAS awake tracheal intubation guidelines emphasise on the ideal sedation, topicalisation and oxygenation techniques before actually performing the procedure [27]. Nasotracheal intubation is done so as to keep the oral airway free for surgeons to explore. A flexometallic tube is preferred as there is less kinking and compression as compared to a PVC tube [28]. After the airway is secured a throat pack is inserted to prevent blood and tissue debris from entering into the larynx and trachea. This can be inserted either by anaesthetists or operating surgeons [29]. The anaesthesiologist should also be proficient in other airway management techniques including intubation through supraglottic device, transtracheal jet ventilation, etc. as well as front of neck access should the need arise.

Q: What Will Be the Airway Management Plan in the Above Case Scenario?

1.6 Trismus

Trismus in oral cancer patients is mostly due to treatment related to the cancer or the tumour growth itself that causes tonic contraction of the muscles of mastication resulting in mouth opening less than 3.5 cm [30]. Trismus is a common side effect of head and neck cancer treatment. 38–42%

of people with carcinoma head and neck suffer from trismus. This occurs due to radiation-induced fibrosis of temporomandibular joint or muscles of mastication. Surgical procedures in that area may also result in restricted mouth opening [31].

1.6.1 Airway Management in Trismus

Trismus results in a state of difficult airway management. On the basis of mouth opening, trismus can be graded into mild, moderate or severe [31]. In trismus with mild grade where mouth opening is a possibility following muscle relaxation, a check laryngoscopy before giving relaxant can be done. In moderate to severe grade trismus awake fibreoptic intubation can be planned. If the anaesthetists are proficient a blind nasal intubation can be tried. Surgeons should always be on standby to perform tracheostomy whenever any emergency arises and the airway becomes endangered [32].

1.7 Intraoperative Monitoring

Apart from ASA standard monitors, invasive arterial blood pressure monitoring may be required if the patient has associated comorbidities. Arterial cannulas are to be avoided in the arm where radial forearm flap is planned. Urinary catheterisation is required as the surgery is of prolonged duration.

Q: What Are the Other Anaesthetic Concerns in This Case Apart from Difficult Airway?

1.8 Position of the Patient

The patient is placed in a reverse Trendelenburg position to prevent venous congestion, reduce blood loss and clear surgical fields. However, there is a chance of venous air embolism with such position and a close observation on the end-tidal CO_2 should be kept [33]. The arms are tucked to the side of the patient and adequate padding should be done to prevent peripheral nerve injury. The venous access in the upper limbs may be difficult to the arms being tucked away and need for extension tubings.

1.9 Perioperative Management Including ERAS

The ERAS guidelines for head and neck cancer can be summarised in the following points [23, 34]:

Preoperative phase:

1. Patients are given a diary that consists of steps at various time points before and after surgery.
2. Preoperative psychological optimisation by meeting with clinical psychologists and patients who have undergone similar procedure.
3. Patients are encouraged for preoperative exercises and nutritional optimisation.
4. Carbohydrate preloading before surgery.
5. Avoid long-acting sedative premedication.

Intraoperative phase:

1. Standard anaesthesia protocol to be followed.
2. Cardiac output monitoring for goal-directed fluid therapy.
3. Rationalisation on the use of tracheostomy.
4. Prevention of hypothermia, adequate analgesia and antibiotic prophylaxis are to be given.

Postoperative phase:

1. Early extubation plan.
2. Early ambulation.
3. Adequate analgesia.
4. Early oral feeding to be established as soon as possible after extubation.

Q: When Is Free Flap Done in Carcinoma Buccal Mucosa? What Are Its Anaesthetic Concerns? How Will You Monitor Flap Patency in the Postoperative Period?

1.10 Anaesthetic Considerations in Free Flap

Free flap reconstruction is required in surgeries with extensive defects. Here a neurovascular pedicle is removed from the donor site and transplanted into a new location via microvascu-

lar anastomosis. This gives rise to a secondary defect which is then repaired. Various donor sites for taking flap includes the radial/ulnar forearm, lattismus dorsi, rectus abdominis, etc. Since this is a microvascular surgery there are chances of failure. Factors resulting in graft failure include inadequate surgical anastomosis, flap oedema due to excess fluids, mechanical compression, vasospasm, thrombosis, excess flap manipulation, generalised vasoconstriction due to hypothermia, hypovolemia, pain, etc. [35]. The prime concern here is to maintain adequate blood supply to the anastomosis. The use of TIVA was associated with less hemodynamic fluctuations [36]. Analgesic management of flap site with epidural or continuous drug infusion catheter can be done. Regional anaesthesia results in sympathetic blockade and vasodilation leading to better flap outcomes. If heparin is used during flap reconstruction, careful monitoring is to be done before epidural removal. Free flap reconstruction procedure warrants the use of invasive arterial line for hemodynamic monitoring. Analgesia, glucose levels, blood loss and urine output should be monitored to prevent flap failure. The transfusion trigger should be maintained at a haematocrit level of 25% to prevent increase rate of blood transfusion [37]. Vasoconstrictors like noradrenaline use have been found to be beneficial in maintaining blood flow to the flap; use of intravenous dexmedetoidine has been found to have similar effect [38, 39].

1.10.1 Postoperative Flap Monitoring

Flaps should be monitored for 24 h postoperatively for any kind of vasospasm, oedema and signs of necrosis. Re-exploration may be required if signs of ischemia emerge Use of dexamethasone and mannitol along with head elevation has been found to decrease graft oedema [40]. Various techniques of flap viability monitoring include from simple clinical examination (colour of flap site, capillary refill, temperature monitoring, etc.) to use of Doppler to check vascular flow. PO_2 monitoring of flap site can also be done [41, 42].

1.11 Venous Thromboembolism Prophylaxis

The incidence of deep vein thrombosis (DVT) ranges from 15 to 30% in patients undergoing surgery without any prophylaxis. But the presence of cancer increases the risk to 40–80% [43]. Patients of head and neck cancer undergoing free flap reconstruction require VTE prophylaxis as they are at moderate to high risk for the same [44]. Pharmacologic prophylaxis in the form of low molecular weight heparin is the prophylaxis of choice here. There may be an increased risk for bleeding with simultaneous use of antiplatelets, and individualisation of prophylaxis is always better [23, 45].

1.12 Tracheostomy

Tracheostomy is not done preoperatively unless emergency as it can interfere with delineation of tumour anatomy and resection. Intraoperative tracheostomy is often performed at the end of the surgical procedure if mandibular resection crosses midline with excision of both genial tubercles that cause tongue fall, extensive palatal resection or buccal mucosa resection requiring a flap [46]. During change from endotracheal tube to tracheostomy, ventilation should be done with 100% oxygen and suctioning of oral cavity and ETT to be done before removal. Sometimes a J-shaped laryngectomy tube may be inserted through the tracheostomy and sutured to chest wall. Correct position of tracheostomy should be ascertained with end-tidal CO_2 monitoring and auscultation. Although it is a safe procedure, tracheostomy may increase hospital stay [47]. Decannulation and closure of stoma is done later with respiratory and swallowing rehabilitation. In most cases, patients can be safely decannulated within 1 week of surgery [23].

1.13 Extubation

Extubation in patients undergoing hemimandibulectomy for buccal mucosa cancer depends on various factors like duration of surgery, dissection during surgery, degree of oedema, etc. The patients are mostly kept intubated overnight in the intensive care unit to let the oedema subside and extubation attempted on the next morning. The extubation process like intubation should also be planned immaculately. Guidelines pertaining to extubation of the difficult airway should be followed [48, 49]. All equipments arranged for intubation purpose should be kept for extubation as well.

1.14 Criteria for ICU Admission in the Postoperative Perio

1. Elective mechanical ventilation.
2. Extensive resection with free flap reconstruction.
3. Intraoperative hemodynamic instability.
4. Elderly patients with comorbidities requiring monitoring.

Q: How Will You Manage Pain in This Case? If the Patient Was Already Taking Opioids Preoperatively, What Will Be Your Analgesia Management Plan?

1.15 Analgesia Management

Preemptive analgesia as part of multi-modal analgesia reduces postoperative pain. NSAIDs play a key role in pain management as the cancer pain in buccal mucosa tumour is inflammatory in nature [23]. Opioids as well as other adjuvants should be used together to decrease the cumulative dose of a single agent. Paracetamol should be given round the clock. Celecoxib can be added as it was found to have minimal effect on flap blood flow [50]. Use of COX-1 inhibitors has been found to be associated with surgical bleeding and should be individualised [51]. Use of patient-controlled analgesia (PCA) pumps with morphine or fentanyl has been found to be beneficial in the postoperative period [52]. Patients with severe cancer-related pain who are on opioids preoperatively with or without adjuvant therapy are difficult to treat in the perioperative period. It is imperative that these patients receive their usual dose of opioids before surgery and additional opioids can be administered intra- and postoperatively. Adequate adjuvants should be added in the postoperative period. Patients are to be monitored for signs of opioid withdrawal (hypertension, tachycardia, diaphoresis). According to FDA, an opioid-tolerant patient is one who receives: 60 mg/day oral morphine or transdermal fentanyl 25 mcg/h or oxycodone, hydromorphone, oxymorphone orally 30 mg/day, 8 mg/day. 25 mg/day respectively or any equianalgesic dose of other opioids for a period of at least 7 days. Patients who are opioid tolerant will require more opioid doses than opioid naïve patients [53]. The administration of opioids should be carefully titrated so as to decrease its side effects like respiratory depression, sedation, etc. while at the same time achieving its goal of adequate analgesia. Substituting a different opioid when one opioid is unable to provide adequate analgesia even with increase doses is called opioid rotation. This is mainly done in patients with opioid tolerance. Here, the new opioid is initially started at one-half to two-thirds equianalgesic dose and observed for side effects. Substituting a long acting opioid with a short acting one may result in precipitation of withdrawal symptoms [53, 54].

References

1. Global Cancer Observatory [Internet]. Cancer (IARC) TIA for R on. https://gco.iarc.fr/. Accessed 21 Jul 2022.
2. Argiris A, Karamouzis MV, Raben D, Ferris RL. Head and neck cancer. Lancet. 2008;371(9625):1695–709.
3. Moore SR, Johnson NW, Pierce AM, Wilson DF. The epidemiology of mouth cancer: a review of global incidence. Oral Dis. 2000;6(2):65–74.
4. Singhania V, Jayade BV, Anehosur V, Gopalkrishnan K, Kumar N. Carcinoma of buccal mucosa: a site specific clinical audit. Indian J Cancer. 2015;52(4):605.
5. Chi AC, Day TA, Neville BW. Oral cavity and oropharyngeal squamous cell carcinoma—an update. CA Cancer J Clin. 2015;65(5):401–21.

6. Sonowal DSJ. Anaesthetic considerations for head and neck cancers in patients undergoing reconstructive free flap surgeries—a review of 55 patients. Clin Med. 2020;7(2):8.
7. Tandon P, Dadhich A, Saluja H, Bawane S, Sachdeva S. The prevalence of squamous cell carcinoma in different sites of oral cavity at our Rural Health Care Centre in Loni, Maharashtra—a retrospective 10-year study. Contemp Oncol (Pozn). 2017;21(2):178–83.
8. Perrier M, Moeller P. Osteoradionecrosis. A review of the literature. Schweiz Monatsschr Zahnmed. 1994;104(3):271–7.
9. Balakrishnan M, Kuriakose R, Koshy RC. Radiation induced changes in the airway—anaesthetic implications. S Afr J Anaesth Analg. 2004;10(2):19–21.
10. Groenewold MD, Olthof CG, Bosch DJ. Anaesthesia after neoadjuvant chemotherapy, immunotherapy or radiotherapy. BJA Educ. 2022;22(1):12–9.
11. Pai VB, Nahata MC. Cardiotoxicity of chemotherapeutic agents: incidence, treatment and prevention. Drug Saf. 2000;22(4):263–302.
12. Liston SL. Hypercalcemia and head and neck cancer: bony metastases from tongue cancer. Arch Otolaryngol. 1978;104(10):597–600.
13. Jain K, Gupta N, Yadav M, Thulkar S, Bhatnagar S. Radiological evaluation of airway—what an anaesthesiologist needs to know! Indian J Anaesth. 2019;63(4):257–64.
14. Bhaskar SB. Newer airway assessment techniques: a view on their utility. Indian J Anaesth. 2017;61(10):779–81.
15. Kanaya N, Kawana S, Watanabe H, Niiyama Y, Niiya T, Nakayama M, et al. The utility of three-dimensional computed tomography in unanticipated difficult endotracheal intubation. Anesth Analg. 2000;91(3):752–4.
16. van den Berg MGA, Rasmussen-Conrad EL, van Nispen L, van Binsbergen JJ, Merkx MAW. A prospective study on malnutrition and quality of life in patients with head and neck cancer. Oral Oncol. 2008;44(9):830–7.
17. Nesemeier R, Dunlap N, McClave SA, Tennant P. Evidence-based support for nutrition therapy in head and neck cancer. Curr Surg Rep. 2017;5(8):18.
18. Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clin Nutr. 2017;36(1):11–48.
19. August DA, Huhmann MB, American Society for Parenteral and Enteral Nutrition. A.S.P.E.N. clinical guidelines: nutrition support therapy during adult anticancer treatment and in hematopoietic cell transplantation. JPEN J Parenter Enteral Nutr. 2009;33(5):472–500. https://doi.org/10.1177/0148607109341804.
20. Roussel LM, Micault E, Peyronnet D, Blanchard D, Guarnieri S, Choussy O, et al. Intensive nutritional care for patients treated with radiotherapy in head and neck cancer: a randomized study and meta-analysis. Eur Arch Otorrinolaringol. 2017;274(2):977–87.
21. Ames JA, Karnell LH, Gupta AK, Coleman TC, Karnell MP, Van Daele DJ, et al. Outcomes after the use of gastrostomy tubes in patients whose head and neck cancer was managed with radiation therapy. Head Neck. 2011;33(5):638–44.
22. Lassen K, Soop M, Nygren J, Cox PBW, Hendry PO, Spies C, et al. Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. Arch Surg. 2009;144(10):961–9.
23. Dort JC, Farwell DG, Findlay M, Huber GF, Kerr P, Shea-Budgell MA, et al. Optimal perioperative care in major head and neck cancer surgery with free flap reconstruction: a consensus review and recommendations from the enhanced recovery after surgery society. JAMA Otolaryngol Head Neck Surg. 2017;143(3):292–303.
24. Apfelbaum JL, Hagberg CA, Connis RT, Abdelmalak BB, Agarkar M, Dutton RP, et al. 2022 American Society of Anesthesiologists practice guidelines for management of the difficult airway*. Anesthesiology. 2022;136(1):31–81.
25. Myatra SN, Shah A, Kundra P, Patwa A, Ramkumar V, Divatia JV, et al. All India Difficult Airway Association 2016 guidelines for the management of unanticipated difficult tracheal intubation in adults. Indian J Anaesth. 2016;60(12):885–98.
26. Difficult Airway Society. DAS guidelines for management of unanticipated difficult intubation in adults 2015. https://das.uk.com/guidelines/das_intubation_guidelines. Accessed 6 Aug 2022.
27. Ahmad I, El-Boghdadly K, Bhagrath R, Hodzovic I, McNarry AF, Mir F, et al. Difficult Airway Society guidelines for awake tracheal intubation (ATI) in adults. Anaesthesia. 2020;75(4):509–28.
28. Garcha P, Sreevastava D, Singh S. Flexometallic endotracheal tube and nasal intubation. Med J Armed Forces India. 2000;56(1):88.
29. Gupta A, Sarma R, Gupta N, Kumar R. Current practices and beliefs regarding the use of oropharyngeal throat pack in India: a nationwide survey. Indian J Anaesth. 2021;65(3):241–7.
30. Agarwal P, Shiva Kumar HR, Rai KK. Trismus in oral cancer patients undergoing surgery and radiotherapy. J Oral Biol Craniofac Res. 2016;6(Suppl 1):S9–13.
31. Santiago-Rosado LM, Lewison CS. Trismus. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2022. http://www.ncbi.nlm.nih.gov/books/NBK493203/.
32. Kapre V. Anesthesia for surgery of trismus due to OSMF. In: Kapre M, Kothe S, editors. Surgery of trismus in oral submucous fibrosis. Singapore: Springer Singapore; 2018. p. 11–6. https://doi.org/10.1007/978-981-10-4892-0_3.
33. Türe H, Harput MV, Bekiroğlu N, Keskin Ö, Köner Ö, Türe U. Effect of the degree of head elevation on the incidence and severity of venous air embolism in cranial neurosurgical procedures with patients in the semisitting position. J Neurosurg. 2018;128(5):1560–9.
34. Coyle MJ, Main B, Hughes C, Craven R, Alexander R, Porter G, et al. Enhanced recovery after surgery

(ERAS) for head and neck oncology patients. Clin Otolaryngol. 2016;41(2):118–26.
35. Goswami U, Jain A. Anaesthetic implications of free-flap microvascular surgery for head and neck malignancies—a relook. J Anaesthesiol Clin Pharmacol. 2021;37(4):499–504.
36. Chang YT, Wu CC, Tang TY, Lu CT, Lai CS, Shen CH. Differences between total intravenous anesthesia and inhalation anesthesia in free flap surgery of head and neck cancer. PLoS One. 2016;11(2):e0147713.
37. Rossmiller SR, Cannady SB, Ghanem TA, Wax MK. Transfusion criteria in free flap surgery. Otolaryngol Head Neck Surg. 2010;142(3):359–64.
38. Monroe MM, Cannady SB, Ghanem TA, Swide CE, Wax MK. Safety of vasopressor use in head and neck microvascular reconstruction: a prospective observational study. Otolaryngol Head Neck Surg. 2011;144(6):877–82.
39. Yang X, Li Z, Gao C, Liu R. Effect of dexmedetomidine on preventing agitation and delirium after microvascular free flap surgery: a randomized, double-blind, control study. J Oral Maxillofac Surg. 2015;73(6):1065–72.
40. Offodile AC, Aherrera A, Wenger J, Rajab TK, Guo L. Impact of increasing operative time on the incidence of early failure and complications following free tissue transfer? A risk factor analysis of 2008 patients from the ACS-NSQIP database. Microsurgery. 2017;37(1):12–20.
41. Abdel-Galil K, Mitchell D. Postoperative monitoring of microsurgical free tissue transfers for head and neck reconstruction: a systematic review of current techniques—part I. Non-invasive techniques. Br J Oral Maxillofac Surg. 2009;47(5):351–5.
42. Abdel-Galil K, Mitchell D. Postoperative monitoring of microsurgical free-tissue transfers for head and neck reconstruction: a systematic review of current techniques—part II. Invasive techniques. Br J Oral Maxillofac Surg. 2009;47(6):438–42.
43. Agnelli G. Prevention of venous thromboembolism in surgical patients. Circulation. 2004;110(24 Suppl 1):IV4–12.
44. Shuman AG, Hu HM, Pannucci CJ, Jackson CR, Bradford CR, Bahl V. Stratifying the risk of venous thromboembolism in otolaryngology. Otolaryngol Head Neck Surg. 2012;146(5):719–24.
45. Bahl V, Shuman AG, Hu HM, Jackson CR, Pannucci CJ, Alaniz C, et al. Chemoprophylaxis for venous thromboembolism in otolaryngology. JAMA Otolaryngol Head Neck Surg. 2014;140(11):999–1005.
46. Chaukar D, Dandekar M. Surgical resection of cancer of the buccal mucosa. Open Access Atlas Otolarygngol Head Neck Oper Surg Cape Town UCT Librariespp. 33:1–21.
47. Moore MG, Bhrany AD, Francis DO, Yueh B, Futran ND. Use of nasotracheal intubation in patients receiving oral cavity free flap reconstruction. Head Neck. 2010;32(8):1056–61.
48. Kundra P, Garg R, Patwa A, Ahmed SM, Ramkumar V, Shah A, et al. All India Difficult Airway Association 2016 guidelines for the management of anticipated difficult extubation. Indian J Anaesth. 2016;60(12):915–21.
49. Difficult Airway Society Extubation Guidelines Group, Popat M, Mitchell V, Dravid R, Patel A, Swampillai C, Higgs A. Difficult Airway Society Guidelines for the management of tracheal extubation. Anaesthesia. 2012;67(3):318–40.
50. Wax MK, Reh DD, Levack MM. Effect of celecoxib on fasciocutaneous flap survival and revascularization. Arch Facial Plast Surg. 2007;9(2):120–4.
51. Stammschulte T, Brune K, Brack A, Augenstein H, Arends G, Gundert-Remy U. Unexpected hemorrhage complications in association with celecoxib. Spontaneously reported case series after perioperative pain treatment in gynecological operations. Anaesthesist. 2014;63(12):958–60.
52. Jellish WS, Leonetti JP, Sawicki K, Anderson D, Origitano TC. Morphine/ondansetron PCA for postoperative pain, nausea, and vomiting after skull base surgery. Otolaryngol Head Neck Surg. 2006;135(2):175–81.
53. Mehta V, Langford RM. Acute pain management for opioid dependent patients. Anaesthesia. 2006;61(3):269–76.
54. Texas AA PharmD, BCPS Assistant Professor Ambulatory Care Division Department of Pharmacy Practice Texas Tech University Health Sciences Center School of Pharmacy Clinical Pharmacy Specialist VA North Texas Health Care System—Dallas Dallas, Texas Nakia Duncan, PharmD, BCGP, BCPS Assistant Professor—Geriatrics Division Department of Pharmacy Practice Texas Tech University Health Sciences Center School of Pharmacy Palliative Care Clinical Pharmacy Specialist UT Southwestern Medical Center Dallas. Acute Pain Management in Patients With Opioid Tolerance [Internet]. https://www.uspharmacist.com/article/acute-pain-management-in-patients-with-opioid-tolerance. Accessed 7 Aug 2022.

2 Anaesthesia and Perioperative Concerns in Total Laryngectomy

Saurabh Vig, Ankit Sharma, and Swati Bhan

2.1 Case Vignette

A 54-year-old male presented to ENT OPD with chief complaints of hoarseness and foreign body sensation in the throat for 3 months. Initial laryngoscopic examination revealed a lesion with an irregular surface on his right vocal cord. Head and neck CT revealed that the lesion had invaded the anterior commissure of the larynx and the glottis through the length. The patient had no other significant medical or surgical history. He was an ex-smoker (20 pack-years, reformed for 3 months), and a social drinker. Whole-body PET-CT showed no sign of metastasis. The patient was referred to Head and Neck Oncology and posted for total laryngectomy.

2.1.1 Define Total Laryngectomy? Contrast It with Other Partial Surgical Modalities

Total laryngectomy is defined as the en-bloc removal of laryngeal structures (i.e. hyoid, epiglottis and some amount of upper trachea) and creation of a permanent tracheostome. A part of or total thyroid gland may be removed as a part of this procedure which may require postoperative thyroxine replacement [1]. Other surgical

S. Vig
Department of Onco-Anaesthesia and Palliative Medicine, National Cancer Institute, AIIMS, New Delhi, New Delhi, India

A. Sharma
Department of Onco-Anaesthesia and Palliative Medicine, BRAIRCH, AIIMS, New Delhi, New Delhi, India

S. Bhan (✉)
Department of Anaesthesia and Critical Care, VMMC and Safdarjung Hospital, New Delhi, India

N. Gupta et al. (eds.), *Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care*, https://doi.org/10.1007/978-981-99-6339-3_2

modalities available which preserve some part of larynx are:

- Cordectomy—Surgical removal of vocal cords.
- Hemi/partial laryngectomy—Only on half of larynx removed, voice is usually preserved in this surgery.
- Supraglottic laryngectomy—Removal of larynx above the glottis only, voice is preserved in this surgery.
- Transoral laser microsurgery—It is a minimally invasive endoscopic approach involving the use of suspension laryngoscopy with an operating microscope, a tissue-cutting laser, and microsurgical instruments to resect the laryngeal tumour. In contrast to partial laryngectomy, the cartilage framework of the larynx is preserved, thus reducing the need for tracheostomy allowing more rapid return of postoperative swallowing, and shorter hospital stays. The oncological results with this surgery are comparable with open partial laryngectomy.

2.1.2 What Are the Quality of Life Affecting Concerns in a Patient Planned for 'Total Laryngectomy'?

Laryngectomy impacts the life of a patient in a big way. Altered body image after surgery, inability to speak naturally for the rest of life, learning and training oneself with a new method of communication for the rest of life, and breathing through the neck are some of the main concerns which may plague the mind of a patient and the caregivers having negative impact on quality of life [2, 3].

Plan of rehabilitation discussed at the time of planning the surgery with multidisciplinary team involving a voice therapist, and nursing team specializing in care of a neck breather may help to alleviate these concerns and lead to better patient outcome and satisfaction.

2.1.3 What Is the Incidence of Laryngeal Cancer in India and Worldwide? What Are the Main Risk Factors Associated with This Malignancy?

Laryngeal cancer is the seventh most common malignancy among males in India and the ninth most common in males worldwide. It is more common in males and accounts for 3–6% of all cancers in males and 0.2–1% of all cancers in females in India. Common risk factors associated are tobacco use and alcohol consumption. The 5-year survival rate after treatment is around 28% [4].

2.1.4 Describe the TNM Staging for Ca Larynx

The 'T' staging ranges from T1 to T4b and consists of various sized and local spread of the lesion in supraglottic, glottic and subglottic areas. Underlying basis of classifying growths from T1, i.e. limited local site involvement to increasing in size and spreading to nearby structures in and outside larynx. T2 being invasion of adjacent structures, T3 being growths involving vocal cords, para glottic space and leading to cord fixation and T4 being invasion through the thyroid or cricoid cartilages into the prevertebral space, encasement of carotid artery and nearby mediastinal structures.

For lymph nodal spread description ranges from N0 to N3b where N0 means no lymph nodal spread, N1 being single ipsilateral lymph node which measures less than 3 cm, a single node on ipsilateral side of mass between 3–6 cm comes under N2a, and multiple ipsilateral nodes 3–6 cm are N2b, N2c is bilateral or contralateral nodes all less than 6 cm and any node more than 6 cm or any extranodal regional metastasis comes under N3a and N3b respectively.

2.1.5 How Do You Evaluate and Prehabilitate These Patients?

- A thorough preoperative assessment that includes relevant history and investigations should be done.
- Most of these patients are smokers, so cardiovascular and respiratory diseases are common. Symptoms like unstable angina, history of recent stenting, major cardiac conditions like heart failure on medication, or a valvular heart disease would warrant for a cardiologist opinion for risk stratification and perioperative management.
- Evaluating for exercise tolerance is an essential part of pre-anaesthetic check-up. Cardiopulmonary exercise testing (CPET) is a useful aid in risk-stratifying patients. But in patients with critical airway stenosis due to the laryngeal pathology, CPET can precipitate airway obstruction and hence, contra-indicated.
- Some of these patients could have received preoperative radiotherapy. It is essential to assess airway for potential difficulties in management. The attending anaesthesiologist should also be aware of the airway-related changes due to radiotherapy. Radiotherapy can result in oral mucositis, oral thrush, and oro-cutaneous fistulae which leads to friable mucosa and increased bleeding. It causes fibrosis of temporo-mandibular joint and floor of mouth, glossomegaly, tongue oedema (decreased tongue movement), risk of caries, increased mobility and loss of teeth, osteoradionecrosis and pathological fracture of mandible, micrognathia, altered neck consistency which becomes hard, woody and indurated leading to difficult mask ventilation and laryngoscopy. It also causes laryngeal oedema leading to difficult visualization of larynx and tracheal intubation. Acute or chronic baroreflex dysfunction, hypothyroidism can also occur following head and neck radiotherapy. Tissue Fibrosis due to radiation involves tissue atrophy and contractures (such as trismus), and cannot be relaxed with neuromuscular blocking agents (NMBAs).
- Few patients might have received concurrent chemoradiation with agents such as cisplatin, carboplatin, docetaxel, and cituxumab. They should be evaluated for the presence of renal toxicity, hypomagnesemia, neurological toxicity and haematological toxicity.
- Head and neck cancer patients could be on opioids for pain management. A perioperative opioid management plan is needed for optimal pain management.
- Nutritional assessment is an important part of evaluation and prehabilitation. Nutrition counselling and dietary advice, tube nutrition, parenteral nutrition, and nutritional supplements are some of the measures that can be used to combat malnutrition. A caloric intake of 25–30 kcal/kg/day together with 1.2–1.5 g protein/kg/day which could be increased to 2 g/kg/day in severe catabolism is recommended.
- Medical optimization which includes cessation of smoking and alcohol intake, weight optimization, correction of anaemia, blood glucose optimization, and optimization of comorbidities should be started 4–6 weeks prior to surgery.
- Aerobic and resistance exercises help to improve the functional capacity of the patients.
- Psychological interventions such as deep breathing, meditation and hypnosis reduce anxiety and motivate patients to comply with medical and nutritional interventions.
- Scoring systems such as ACS-NSQIP, SORT, POSSSUM, APACHE 2 and Charlson index can be used in predicting morbidity although none of these has been validated for use in laryngectomy.

2.1.6 What Are the Toxicities Associated with Chemotherapeutic Agents Used in Ca Larynx?

Major toxicities of chemotherapy on various organ systems are listed in Table 2.1; toxicity profile of agents specifically used in head and neck malignancies are summarized in Table 2.2.

Table 2.1 Chemo-toxicities

Toxicity	Manifestations
Myelosuppression	Neutropenia, thrombocytopenia, anaemia, microangiopathic haemolytic anaemia (carboplatin)
Cardiotoxicity	• Brady and tachyarrhythmias, conduction disorders, myocardialIschaemia, may be seen with concomitant cisplatin therapy • Peripheral oedema due to fluid retention (docetaxel)
GI	Diarrhoea, mucositis, vomiting
CNS	Encephalopathy, ototoxicity, vestibulopathy, cognitive impairment, GB syndrome (rare), reversible posterior leukoencephalopathy syndrome
PNS	Paresthesias, dysesthesias of the hands, feet. Cold-induced pharyngolaryngeal dysesthesias; and muscle cramps. Distal axonal neuropathy without motor involvement
Pulmonary	Pneumonitis, interstitial pneumonia, eosinophilic pneumonia, diffuse alveolar damage, etc.
Electrolyte abnormalities	Hypokalaemia, hypomagnesemia
Dermatotoxicity	Infusion reactions, alopecia

Table 2.2 Toxicities associated with different chemotherapeutic agents

Chemotherapy agent	M	GI	C	CNS	PNS	R	E	H	D	HS	P	N
Cisplatin	+	–	–	++	+++	++	+	–	+		+	++
Carboplatin	+	+	–		+++	+				++		
Docetaxel	+	++		+							+	
Cetuximab	++		+		++	+	+	+	++	+		
5 FU	+	+	++	+					+			

M myelosuppression, *C* cardiotoxicity, *CNS* central nervous system, *R* renal toxicity, *E* electrolyte abnormalities, *H* hepatotoxicity, *D* dermatologic toxicity, *PN* peripheral nervous system, *GI* gastrointestinal, *HS* hypersensitivity reactions, *P* pulmonary toxicity, *N* nausea and vomiting

2.1.7 What Can Be the Airway-Related Concerns in a Patient of Ca Larynx Posted for Total Laryngectomy? [5–7]

The current surgical management protocols favour organ-preserving strategy and total laryngectomy is mainly done in advanced lesions (T4 on TNM staging). Also, preoperative tracheostomy is generally avoided as it is associated with poorer wound healing and higher rate of cancer recurrence in the tracheostomy stoma. Thus, the anaesthetist should be well versed in intubating a case of laryngeal cancer as the glottic aperture may be compromised with poor/restricted view on laryngoscopy. In addition to keeping in mind the difficult airway management guidelines [5–7] the following are the specific points of concern when anaesthetizing and securing airway in a carcinoma larynx for total laryngectomy:

A. Preoperative signs of airway obstruction.
B. Specific concerns in a patient with a history of radiotherapy to the larynx.
C. Estimating size of laryngeal aperture using preoperative radiological scans.
D. Choice of tracheostomy tube.
E. Planning and predicting difficult front of neck access for emergency airway management.

Each of the points of difficulty should be approached with a primary plan and an emergency plan B in mind.

A. Preoperative signs of airway obstruction—preoperative visit should specifically focus on eliciting signs and symptoms of airway obstruction. Points in history pointing to an airway obstruction are dysphagia, voice change, breathlessness, or orthopnoea. In a

patient reporting breathing difficulty in supine position, the most comfortable position while sleeping should be noted and preoxygenation and anaesthetic induction should be done in this position. Narrowing of laryngeal aperture leading to obstruction of airway can also give rise to situations of difficult bag and mask ventilation as the overlying growth may be floppy and obstruct the airway completely once muscle relaxant has been given. High-flow nasal oxygen and THRIVE is helpful especially in patients with stridor.

B. Specific concerns due to radiotherapy of larynx—a patient previously treated with an organ-preserving approach with radiotherapy to the larynx will invariably be a difficult airway. Radiotherapy can produce an array of changes in the airway ranging from inflammation, oedema to fibrosis and narrowing of the laryngeal inlet with distortion of anatomy. In severe cases, radiotherapy-induced changes can lead to an entity called as '*Frozen Larynx*' which is defined as a fixed immobile larynx with cord palsies and dysphagia. Such an airway is particularly difficult to manage and every case of preoperative radiotherapy should be treated as an anticipated difficult airway.

C. Estimating laryngeal aperture size and specific endotracheal tubes for laryngectomy—

A secure airway (inside the trachea and with a seal cuff) is necessary during laryngectomy to protect the pulmonary tree and alveoli from blood and secretions trickling down. A cuffed endotracheal tube also prevents leakage of anaesthetic gas or oxygen. Since the surgical field and the airway is a shared space between the anaesthetist and the surgeon the endotracheal tube may interfere with the surgical field and hence impede the dissection of the larynx and the neck. Thus, care should be taken to place an appropriately sized and carefully secure it keeping in mind the chances of dislodgment or kink during surgery.

The size of the endotracheal tube can be predicted based on direct visualization techniques such as Indirect laryngoscopy (to see 'chink' between vocal cords) and nasendoscopy, which may also help to visualize any possible narrowing beyond the vocal cords. However, these techniques have a drawback of not providing an objective value for the size of the endotracheal tube, and may not predict any further narrowing beyond the vocal cords or any significant narrowing beyond which an endoscope may not advance.

Computerized tomography (CT) and magnetic resonance imaging are available preoperatively for many surgical patients. The axial images can show narrow points of the airway—the thinner the slices the more accurate the details (Image 2.1). The sagittal and/or coronal

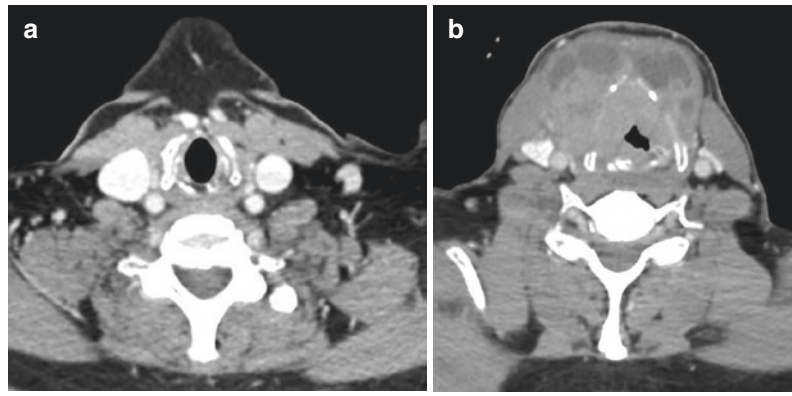


Image 2.1 (**a**) Axial section CT image at level of thyroid cartilage showing normal airway, (**b**) axial section at same level showing growth and reduced glottic aperture, minimal diameter at axial view used to calculate endotracheal tube size (minimum diameter on axial cut corresponds to maximum external diameter of the MLS/small sized flexometallic tube that can pass through the aperture. (*Image source—authors own personal image database, all patient details concealed)

cuts can estimate the length of such narrow segments. Using the scale available on these 'slices', we can objectively measure the largest diameter at the narrowest site, which will be the maximum permissible outer diameter of the endotracheal tube planned for the patient. 3D reconstruction of airway is now possible using CT images which may provide a virtual layout with accurate diameters, but it is a relatively new entity which may possibly be time-consuming and is resource-dependent.

Based on the predicted/measured narrowest diameter, the smallest endotracheal tube (ETT) capable of supporting ventilation should be used, and care should be taken to avoid laryngeal tissue injury if oral intubation is attempted.

Normal PVC single-lumen endotracheal tubes may be used, although microlaryngeal surgery (MLS) tubes (Image 2.1) have an advantage of having length equivalent to an adult 8 size endotracheal tube but available in small paediatric sized (size 4, 5 and 6—internal diameter 4, 5 and 6 mm and outer diameter 5.6, 6.9 and 8.2 mm respectively with each having same length of 368 mm) for the expected narrow glottic chink and to ensure maximal surgical exposure for the surgeon. These tubes have a special high-volume low-pressure cuff (resting cuff diameter of 25, 27 and 27 mm for size 4, 5 and 6 MLS tube respectively—Image 2.2) to ensure adequate seal of a small paediatric-sized tube in an adult trachea. Their main drawback are the high airway pressures generated during positive pressure ventilation which can lead to lung injury like bullae rupture especially in COPD patients. If appropriate small small-sized flexometallic tubes can also be used to intubate as they are easier to direct away from the external surgical field after fixation with no chances of kinking. Other special tubes available for laryngeal surgeries are—the laryngectomy J-shaped tube or the 'Montando tube'.

D. Device selection for laryngoscopy and role of awake fibreoptic bronchoscopy for intubation—the most useful device for optimal glottic view and the general first choice among airway devices as per international guidelines is a video laryngoscope. Awake fibreoptic is generally considered as the go to technique in any case of predicted difficult airway as the chances of airway loss are minimal, however in cases of laryngeal and growths with narrowed laryngeal inlet the diameter of the patent laryngeal aperture might just be equal to the diameter of the fibreoptic bronchoscope. Such a case leads to a dangerous situation described as *'Cork in the Bottle' phenomenon*. In this situation the laryngeal aperture is completely blocked by the fibreoptic and airway is lost, thus awake fibreoptic may be useful in supraglottic growths causing airway obstruc-

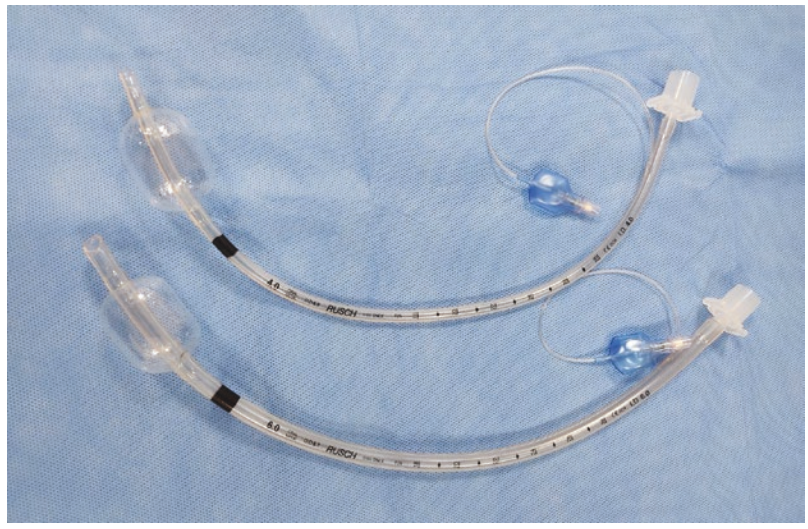


Image 2.2 Size 4 and 6 MLS tubes—note the high volume low pressure cuffs, Length equivalent to adult size 8 ETT (details in text)

tion but not in glottic growths or laryngeal aperture narrowing.

E. Planning and predicting difficult front of neck access—tumours with subglottic or subcricoid extension, preoperative radiotherapy to the neck which may have altered anatomy due to tissue oedema and fibrosis may pose a challenge in front of neck access (FONA) for emergency tracheostomy or cricothyroidotomy. In such cases clear communication with the surgical team should be done regarding the site and approach for a surgical airway access if required.
F. Five questions would help in formulating the airway management strategy
   - How will I pre-oxygenate?
   - Is bag and mask ventilation possible or difficult?
   - Is it possible to get a good view of glottis?
   - Is intubation difficult?
   - Is FONA possible?

Aintree Difficult Airway Management website is a good option for individual airway planning.

2.1.8 Specific Intraoperative Concerns?

Most specific intraoperative concern is the shared airway space between the anaesthetist and the surgeon. This poses the danger of kinking or displacement of the endotracheal tube during the surgery. In the process of surgical dissection and removal of larynx, the surgeon may require the endotracheal tube to be pulled up away from the surgical field. Periods of apnoea may occur during resection and when the tracheal stoma is created and a flexometallic tube is passed through the stoma for ventilation after removing the endotracheal tube.

2.1.9 Role of Enhanced Recovery After Surgery (ERAS) Protocols in Laryngectomy Cases?

There haven't been dedicated guidelines published for ERAS in laryngectomy. Protocols for perioperative management of free flap surgeries are available in the literature [8]. Since the concerns other than flap management and viability, such as those of major debulking, shared airway and proximity to important vascular structures are similar for any major head and neck surgery, many recommendations can be find application in laryngectomy surgery as well.

Importantly, comprehensive preoperative nutritional assessment, with a special focus on dysphagia and risk for refeeding syndrome is of paramount importance.

A standard enteral nutrition formula should be considered in patients requiring preoperative and/or postoperative nutrition support. There is no concrete evidence regarding immunonutrition. Preoperative fasting should be minimized. Clear fluids should be permitted for up to 2 h and solids for up to 6 h prior to anaesthesia and preoperative CHO treatment may be offered. Postoperatively, tube feeding should be initiated within 24 h. Nutrition interventions should be developed in consultation with the multidisciplinary team and individualized according to nutritional status and surgical procedure.

Cancer and major surgery confer risk of venous thromboembolism (VTE). Mechanical prophylaxis is recommended, and pharmacological prophylaxis against VTE should be individualized based on risks and benefit. Perioperative antibiotics in clean-contaminated cases should be given within 1 h of surgery and continued for 24 h.

Postoperative nausea and/or vomiting prophylaxis should include multiple drugs (combination of corticosteroid and antiemetic) should be considered. Long-acting anxiolytics and opioids should be avoided. The anaesthetic protocol should target preventing awareness while minimizing adverse effects and allowing rapid recovery. Normothermia should be maintained intraoperatively. Goal-directed perioperative fluid management, avoiding over and under hydration, is beneficial. Routine intensive care unit admission to facilitate an immediate postoperative period of deep sedation and artificial respiration is not necessary. Low-risk patients with uncomplicated surgery may be treated safely after recovery from anaesthesia

in a high-dependency unit or specialist ward, provided adequate skilled nursing and medical coverage is provided. Opioid-sparing, multimodal analgesia, utilizing NSAIDs, COX inhibitors, and paracetamol, are preferred for such patients. Patient-controlled analgesia can be considered. No concrete evidence or recommendation is available regarding the utility of nerve blocks.

Early postoperative mobilization (preferably within the first 24 h of surgery) is recommended for faster recovery. Urinary catheters should be removed as soon as the patient is able to void, ideally less than 24 h after completion of surgery. Decannulation after tracheostomy and stoma closure (surgical) is recommended. Pulmonary physical therapy should be initiated as early as possible after head and neck reconstructions to avoid pulmonary complications.

2.1.10 Main Postoperative Concerns After Total Laryngectomy?

Main postoperative concerns in the immediate postoperative period (24–48 h) are analgesia, sedation, ventilation and feeding. Usually after total laryngectomy there is no or minimal need for prolonged deep sedation and mechanical ventilation. Efforts must be made to ensure early weaning off from sedation and ventilation to T-piece so the other components of the ERAS pathway like early mobilization, pulmonary physical therapy, removal of indwelling catheters and initiation of feeds can be done as per protocol. Feeding is usually done via nasogastric tube inserted at the time of surgery; however, early resumption of oral feeding after total laryngectomy also finds a mention in the literature [9].

2.1.11 What Are the Available Options for Postoperative Voice Rehabilitation After Laryngectomy and a Permanent Tracheostome? List Out Complications of Such Voice Prosthetic Devices

There are three elements of a functional speech production system—a power source, a sound source, and a sound modifier. In a normal laryngeal speaker, lung air is the power source, the larynx is the sound source, and the vocal tract (i.e., pharynx, oral cavity) functions as the sound modifier. If larynx is removed, the sound source is removed from the equation and hence the power source (lungs) lose their connection with the sound modifier [10, 11].

A tracheo oesophageal puncture (TEP), training in oesophageal speech or inserting a voice prosthetic device (valve/electronic) may be used to restore speech after laryngectomy [12].

- TEP is a surgically created fistula at the back of the tracheal stoma, which creates an opening between the trachea and the oesophagus. It can be done as part of laryngectomy surgery, or as a separate minor procedure after the surgery (a gap of at least 8 weeks). A small tube/catheter or a one-way valve (voice prosthesis) is inserted into the fistula to keep it patent. Once the area has healed, the catheter can be removed, and valve can be fit. If catheter is not inserted, NG tube needs to remain in-situ and feeding done via the same.
- The voice prosthesis is a valve that allows the patient to make sounds by pushing air from the lungs through the valve and up into the oral cavity. The patient has to cover/plug the stoma temporarily so that the air goes

through the valve and does not leak out of the stoma. Using voice prosthesis requires practice, and a speech therapist may help in adjustment to the same. As the pharyngeal muscles get used to it, it becomes easier with passage of time.

- Alternatively, hands-free valves may be used which automatically close the stoma when speaking valve is in use, e.g. Blom-Singer valve, Provox valve, Groningen valve. Blom-Singer and a few Provox valve varieties are external valves and have to be taken out and manually cleaned. Cleaning can be done by the patient after due training. If the valve gets blocked, air can't pass through it easily and the patient won't be able to speak. Groningen and some types of Provox valves are internal valves. They are left in place until they need changing (about every 6 months or if leaking, whichever is earlier). Only a specially trained therapist, doctor or nurse can and must change such a valve.

2.2 Complications of Speech Valves

Pharyngeal muscle spasms may go into spasm because of speech valve. A speech therapist can train the patient to loosen the muscles or botox injections may help. Inflammation and swelling around the valve are other common complications and are due to tissue reaction and/or acid reflux.

- Oesophageal speech is another method where the patient moves air down into the oesophagus which becomes the power source. Forceful swallowing of air is done into the oesophagus and then the air is pushed through the muscles of pharynx, and resultant vibrations can be learnt to be converted to speech by moving mouth and lips.

Advantage of oesophageal speech is no extra apparatus needed, while disadvantage is the limitation to short sentences as patients are unable to produce continuous speech, which requires large quantities of air to be moved into the oesophagus.

Oesophageal speech might also be a better option than an electrolarynx if you think you might have a problem holding something to your throat every time you need to speak.

- Another option is an electronic larynx (electrolarynx) which is a battery-operated machine that produces sound to create a voice. It is usually held against the neck or in the corner of the mouth where it can generate sound which can be modulated by tongue and lips into words. Electrolarynx is useful in patients with any medical contraindication to Voice Prosthesis, and/or too weak for oesophageal sound training. The speech has a mechanical timber which may not be acceptable to some, and it requires plenty of practice and training.

2.2.1 How Do You Manage a Post-laryngectomy Patient Posted for Other Surgical Procedures?

(A) Intubating and securing airway in a patient with partially removed larynx—Presence of tracheal stoma indicates that the whole larynx has been removed. However, absence of stoma is suggestive of partial laryngectomy, and it is important to know this prior to intubation. Partial laryngectomy may be in the form of:
   (a) Vertical partial laryngectomy—here half of the larynx has been excised in the vertical plane, the epiglottis is still present but the larynx appears narrowed.
   (b) Supracricoid laryngectomy here laryngeal structures are excised superior to the level of the cricoid, resulting in a more narrowed and rounded appearance of larynx.

- Tracheal intubation is possible following both of these procedures using a smaller tube size and using videolaryngoscope can aid in visualization of the laryngeal inlet position.

(B) **Management of Laryngectomy Stoma (Post Total Laryngectomy)**

- In these patients, it is important to remember that there is absence of any communication between the mouth and trachea.
- Preoxygenation is to be performed over the laryngeal stoma.
- Ventilation can be performed by placing a paediatric facemask over the stoma site, placing an inflated laryngeal mask airway or the end of a catheter mount over the stoma. Then, laryngectomy tube (J tube) or reinforced tracheal tube can be inserted through the stoma. A cuffed tracheostomy tube can also be placed.
- The main concerns include appropriate mode of delivery of oxygen and management of a 'neck breather' in an environment where they are not normally cared for.

2.2.2 What Are the Complications of Laryngectomy?

Acute complications include postoperative pain, bleeding, dysphagia or odynophagia, and postoperative infections. Chronic complications are tracheopharyngeal and laryngocutaneous fistulas, tracheostomy or feeding tube dependence, long-term fibrosis, dysphagia, and psychosocial distress. Complications of neck dissection include bleeding, raised intracranial pressure due to ligation of internal jugular vein, nerve palsies affecting marginal mandibular branch of the facial nerve (resulting in lower-lip weakness), the hypoglossal nerve (causing loss of movement of the ipsilateral tongue), or the accessory nerve (resulting in stiffening and weakness of shoulder movements). Paralysis of hemidiaphragm can occur due to phrenic nerve damage. Thoracic duct can be damaged leading to chyle leak which is recognized by the presence of a milky fluid in the surgical drains.

References

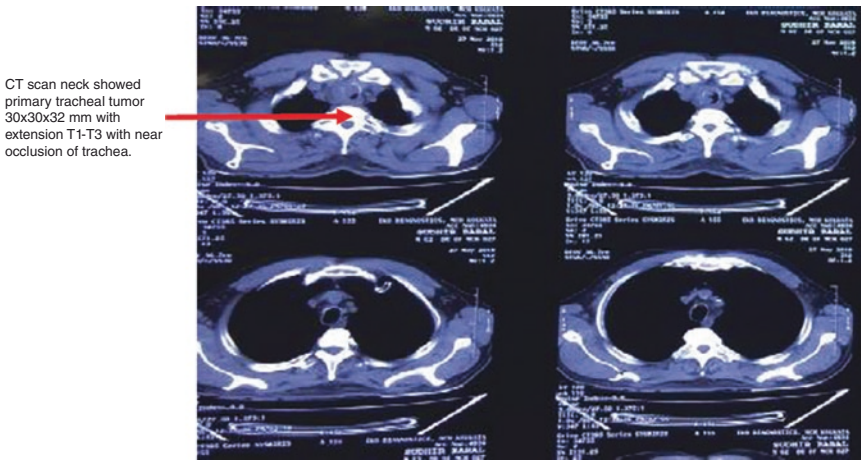
1. Ceachir O, Hainarosie R, Zainea V. Total laryngectomy—past, present, future. Maedica (Bucur). 2014;9(2):210–6. PMID: 25705281; PMCID: PMC4296768.
2. Perry A, Casey E, Cotton S. Quality of life after total laryngectomy: functioning, psychological well-being and self-efficacy. Int J Lang Commun Disord. 2015;50(4):467–75. https://doi.org/10.1111/1460-6984.12148. Epub 2015 Feb 19.
3. Woodard TD, Oplatek A, Petruzzelli GJ. Life after total laryngectomy: a measure of long-term survival, function, and quality of life. Arch Otolaryngol Head Neck Surg. 2007;133(6):526–32. https://doi.org/10.1001/archotol.133.6.526.
4. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S. Cancer statistics, 2020: report from national cancer registry programme, India. JCO Glob Oncol. 2020;6:1063–75.
5. Patel SG, Lydiatt WM, Glastonbury CM, et al. Larynx. In: Amin MB, editor. AJCC cancer staging manual. 8th ed. New York: Springer; 2017.
6. Stephens M, Montgomery J, Urquhart CS. Management of elective laryngectomy. BJA Educ. 2017;17:306.
7. Sinha R, Trikha A, Subramanian R. Microlaryngeal endotracheal tube for lung isolation in pediatric patient with significant tracheal narrowing. Saudi J Anaesth. 2017;11(4):490–3. https://doi.org/10.4103/1658-354X.215427. PMID: 29033734; PMCID: PMC5637430.
8. Dawson P, Rosewane F, Wells D. The Montando laryngectomy tube. Can J Anaesth. 1989;36:486–7.
9. Dort JC, Farwell DG, Findlay M, Huber GF, Kerr P, Shea-Budgell MA, Simon C, Uppington J, Zygun D, Ljungqvist O, Harris J. Optimal perioperative care in major head and neck cancer surgery with free flap reconstruction: a consensus review and recommendations from the enhanced recovery after surgery society. JAMA Otolaryngol Head Neck Surg. 2017;143(3):292–303.
10. Süslü N, Hoşal AŞ. Early oral feeding after total laryngectomy: outcome of 602 patients in one cancer center. Auris Nasus Larynx. 2016;43(5):546–50.
11. Lorenz KJ. Rehabilitation after total laryngectomy—a tribute to the pioneers of voice restoration in the last two centuries. Front Med (Lausanne). 2017;4:81. https://doi.org/10.3389/fmed.2017.00081. PMID: 28695120; PMCID: PMC5483444.
12. https://www.cancerresearchuk.org/about-cancer/laryngeal-cancer/living-with/speaking-after-laryngectomy/voice-prosthesis.

3 Carcinoma Trachea for Tracheal Resection and Anastomosis

Namrata Ranganath, C. S. Sumitha, and Kavitha Lakshman

3.1 Case

A 60-year-old male patient with diagnosis of primary tracheal tumor was posted for emergency tracheal resection and reconstruction. The patient had history of cough, hemoptysis, breathlessness on lying down with audible stridor, diabetic, and hypertensive on treatment. Airway imaging showed tracheal narrowing.



CT scan neck showed primary tracheal tumor 30x30x32 mm with extension T1-T3 with near occlusion of trachea.

N. Ranganath (✉) · C. S. Sumitha · K. Lakshman
Kidwai Memorial Institute of Oncology,
Bangalore, India

N. Gupta et al. (eds.), *Problem Based Learning Discussions in Onco-Anesthesia and Onco-Critical Care*, https://doi.org/10.1007/978-981-99-6339-3_3