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Textbook of
Onco-Anesthesia & Critical Care

Editors
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Sohan Lal Solanki

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CHAPTER 1

Cancer Epidemiology and Onco-Anesthesiology as Emerging Specialty

Sohan Lal Solanki, Jigeeshu V Divatia

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INTRODUCTION

Cancer epidemiology studies the worldwide cancer burden, including risk factors, incidence patterns, and inequalities in disease occurrence. Increasing incidence has driven the development of early detection, precision medicine, and multimodal therapy strategies. Onco-anesthesiology has developed as a subspecialty field for managing the complicated perioperative requirements of cancer patients, incorporating optimized recovery pathways, opioid-sparing strategies, and immunomodulatory anesthetic strategies. There is emerging evidence that anesthetic selection and perioperative management may affect cancer recurrence and long-term survival. This chapter discusses the interaction between cancer epidemiology and onco-anesthesiology, emphasizing their contribution to enhancing global cancer care.

CANCER EPIDEMIOLOGY: A GLOBAL PERSPECTIVE

Cancer remains a major global health challenge, being one of the leading causes of morbidity and mortality worldwide. The latest estimates from the Global Cancer Observatory (GLOBOCAN 2020) report approximately 19.3 million new cancer cases and 10 million deaths due to cancer in a single year.[1] Projections suggest that by 2040, new cancer cases could rise to 28.4 million annually, primarily driven by population growth, aging, and lifestyle changes. Among the most commonly diagnosed cancers are breast cancer, accounting for over 2.2 million cases, followed by lung, colorectal, prostate, and stomach cancers. However, the global distribution of cancer types varies significantly, with lung cancer being predominant in developed regions, while cervical and liver cancers are more prevalent in low- and middle-income countries (LMICs).[2] These disparities reflect differences in exposure to risk factors, healthcare access, and the availability of preventive and diagnostic services. The epidemiological patterns highlight the urgent need for comprehensive cancer control programs that include prevention, early detection, and treatment strategies tailored to regional and cultural contexts.

CANCER EPIDEMIOLOGY IN INDIA

India's cancer burden is growing at an alarming pace, with an estimated 1.4 million new cases and 850,000 deaths annually. The Indian Council of Medical Research (ICMR) predicts that these numbers could increase significantly in the coming years, driven by demographic shifts, urbanization, and the adoption of unhealthy lifestyle habits. The cancer profile in India reveals notable gender and regional disparities. Among women, breast cancer is the leading malignancy, with over 178,000 cases diagnosed annually, often presenting at advanced stages due to lack of awareness and delayed screening.[3] In men, cancers of the oral cavity, lung, and esophagus are most prevalent, largely attributed to tobacco use in various forms. Tobacco-related cancers account for over 30% of the country's cancer burden.[4] Additionally, cervical cancer remains a significant concern among women in rural and underserved regions, despite being largely preventable through vaccination and regular screening. Socioeconomic inequalities further widen the gap in cancer care, with rural populations often lacking access to specialized oncology centers, diagnostic facilities, and treatment options. These factors emphasize the need for strengthened public health policies, including nationwide cancer screening programs, tobacco control initiatives, and equitable access to advanced cancer care.

INTEGRATING CANCER EPIDEMIOLOGY WITH ONCO-ANESTHESIOLOGY

The evolving cancer epidemiological landscape has profound implications for the field of onco-anesthesiology,

a specialized discipline focused on the perioperative management of cancer patients. With cancer surgeries forming a substantial component of oncological treatment, anesthesiologists play a pivotal role in optimizing outcomes through preoperative risk assessment, intraoperative management, and postoperative care. Epidemiological data serve as a critical foundation for understanding the burden and distribution of cancer types, thereby informing tailored perioperative strategies. For instance, the high prevalence of tobacco-related cancers in India necessitates preoperative interventions addressing respiratory and cardiovascular complications associated with chronic tobacco use. Similarly, the rising incidence of breast and gastrointestinal cancers calls for enhanced recovery protocols, multimodal analgesia, and measures to mitigate long-term complications such as chronic pain and opioid dependence.

Furthermore, onco-anesthesiologists are increasingly involved in addressing cancer-related pain syndromes, managing complications of chemotherapy and radiotherapy, and ensuring adequate care for high-risk populations such as the elderly and those with comorbidities. The integration of epidemiological insights with perioperative care practices allows for personalized, evidence-based approaches that improve surgical outcomes, reduce complications, and enhance the quality of life for cancer patients. Onco-anesthesiology, thus, stands at the intersection of epidemiology, oncology, and perioperative medicine, contributing to the holistic management of the growing cancer burden both globally and in regions like India.

ONCO-ANESTHESIOLOGY SPECIALTY

Onco-anesthesiology, an emerging subspecialty, addresses the perioperative care of cancer patients. With advancements in oncology and early cancer detection, increasing numbers of patients with cancer are undergoing surgical interventions. Providing perioperative care for these patients demands specialized knowledge of cancer biology, the effects of chemotherapeutic agents on the body, and how these factors influence anesthesia management and postoperative recovery. This subspecialty plays a crucial role in improving surgical outcomes for cancer patients.

Cancer surgery is often required for diagnostic, therapeutic, or palliative purposes. Over time, advancements in perioperative care have led to improved postoperative outcomes and the establishment of onco-anesthesiology as a distinct and essential specialty within anesthesiology.

SPECIFIC CONCERNS IN ONCO-SURGERIES

Onco-anesthesiology

The subspecialty of onco-anesthesiology focuses on managing the perioperative needs of critically ill cancer patients, addressing acute postoperative pain, and managing chronic cancer pain **(Fig. 1)**.

Evidence suggests that anesthesia drugs and techniques can influence oncological outcomes following cancer surgery. For instance, anesthetic methods may impact the perioperative risk of tumor spread and the activation of micrometastases.

Techniques such as total intravenous anesthesia (TIVA), which may exhibit anti-inflammatory effects, and inhalational anesthetics, which can be immunogenic, highlight the importance of anesthetic choices. Other options, including central neuraxial blocks (which block the adrenergic system), and adjuncts like non-steroidal anti-inflammatory drugs, opioids, and beta-adrenergic blockers, may also play a role in influencing outcomes.

A well-established onco-anesthesiology service can enhance recovery after cancer surgery, reduce treatment costs by minimizing intensive care and hospital stays, and alleviate patient suffering through multimodal pain management and palliative care techniques. Additionally,

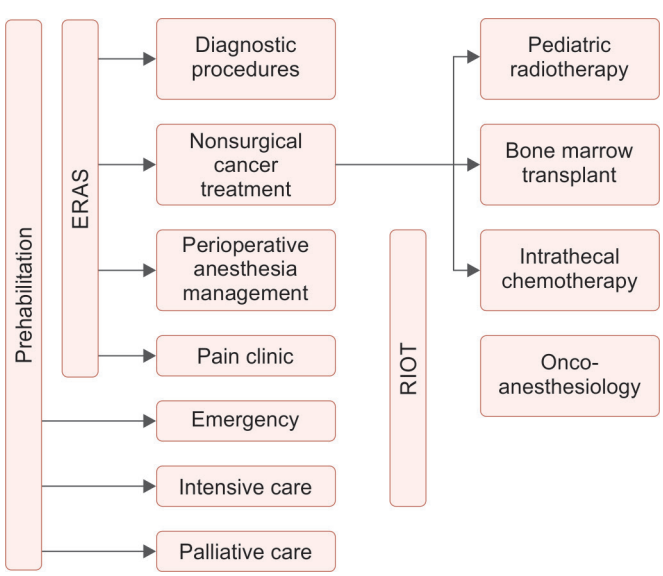


Fig. 1: The onco-anesthesiology. (ERAS: enhanced recovery after surgery; RIOT: return to intended oncological treatment)

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it may contribute to improved disease-free survival and overall survival rates.

Postoperative complications can delay the return to intended oncological treatment (RIOT), adversely affecting survival. Therefore, the goal of perioperative management should be a comprehensive and holistic approach to patient care, aimed at optimizing surgical and oncological outcomes while minimizing the risks of locoregional recurrence and distant metastasis.

Patients Factors

Managing cancer patients presents unique challenges to perioperative physicians due to the intricate nature of their physiological disturbances. These complexities arise from the cancer itself, pre-existing medical conditions, the cumulative effects of chemotherapy or radiation on various organ systems, and the demands of extensive and often lengthy surgical procedures. Additionally, effective pain management in the postoperative period is crucial.

Pain may already be present before surgery due to the underlying disease, and many of these patients may be on preoperative opioids for pain relief. As a result, they often require higher-than-usual doses of opioids during and after surgery, which increases the risk of opioid-related adverse drug events (ORADEs). Moreover, cancer imposes a significant psychosocial burden, necessitating psychological support and counseling as an essential component of preoperative care.

Need for Onco-anesthesia and Onco-critical Care

Cancer surgeries demand dedicated perioperative physicians from the moment the decision to operate is made. Prehabilitation should commence at this stage, focusing on respiratory and physical training, nutritional optimization, emotional support, and counseling. Enhancing physical fitness, implementing respiratory exercises, and improving nutrition before surgery can significantly contribute to better perioperative outcomes. Strength and cardiovascular exercises improve physical capacity, which is vital for patients undergoing major resections and chemotherapy. Poor physical fitness correlates with higher rates of postoperative complications, morbidity, and mortality. Moreover, physical activity may also enhance oncological outcomes. Psychological and cognitive-behavioral interventions form essential components of prehabilitation, alongside medical optimization and nutritional support.

Nutritional therapy aims to restore adequate nutrient reserves before surgery, helping to mitigate the catabolic response associated with the surgical process. Malnutrition increases the risk of complications, infections, prolonged hospital stays, mortality, and readmission. Integrating preoperative nutritional support with exercise training has shown a reduction in postoperative stay, particularly in colorectal surgeries. To achieve optimal nutritional status preoperatively, it is crucial to begin interventions early.

The time available for prehabilitation, from cancer diagnosis to surgery, is often limited. Hence, systemic comorbidities, including cardio-respiratory optimization and preoperative anemia management, must be addressed promptly under the supervision of a perioperative physician.

Complex surgical procedures unique to oncology, such as cytoreductive surgery (CRS) combined with hyperthermic intraperitoneal chemotherapy (HIPEC), pressurized intraperitoneal aerosolized chemotherapy (PIPAC), and ischemic limb perfusion (ILP) with chemotherapeutic agents, require specialized perioperative management.[5] For example, CRS-HIPEC involves administering heated chemotherapeutic drugs into the abdomen via a specialized pump following tumor removal, while PIPAC delivers aerosolized chemotherapy into the abdominal cavity using a pneumoperitoneum.

Other challenging surgeries, such as head and neck cancer surgeries with or without microvascular free tissue transfer, extensive gynecological cancer surgeries, and cases involving the inferior vena cava thrombus or other major vessels, present unique anesthetic and surgical challenges. Onco-anesthesiologists managing such cases must employ advanced techniques, including hemodynamic monitoring, precise fluid management, core temperature regulation, coagulation assessment, and acid-base monitoring.

A dedicated onco-anesthesia team has been shown to improve outcomes in these complex cancer procedures. The enhanced recovery after surgery (ERAS) protocol has also demonstrated significant benefits in postoperative outcomes across various surgeries. Expanding the implementation of ERAS principles in cancer surgeries remains a critical focus of global research.[6]

CHEMOTHERAPY AND ITS IMPLICATIONS

Chemotherapeutic agents used in cancer treatment can cause a wide range of multisystem side effects,

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including severe toxicities and organ damage, which significantly influence perioperative management. Onco-anesthesiologists play a vital role in addressing these complications. Patients who have undergone chemotherapy require a comprehensive preoperative assessment and meticulous perioperative care.

Chemotherapy may be administered as neoadjuvant therapy before surgery, adjuvant therapy during or after surgery, or as palliative care to improve quality of life. Onco-anesthesiologists must possess a thorough understanding of the mechanisms of action, side effects, and toxicities of commonly used chemotherapeutic drugs.[7-9]

For example, bleomycin is known to cause subacute pulmonary damage that can progress to pulmonary fibrosis. During the perioperative period, high oxygen concentrations can exacerbate this condition. Therefore, patients with a history of bleomycin therapy should be ventilated with minimal oxygen concentrations, and the use of positive end-expiratory pressure (PEEP) may help reduce oxygen requirements.[7-9]

Anthracyclines such as doxorubicin and epirubicin directly affect cardiac myocytes and can lead to progressive drug-induced cardiomyopathy. It is essential to assess cardiac contractile function preoperatively in patients with a history of anthracycline use. Invasive cardiac monitoring may also be necessary during surgery for these individuals.[7-9]

Additionally, chemotherapeutic drugs frequently cause gastrointestinal toxicities, including nausea, vomiting, mucositis, and diarrhea. These patients benefit from preoperative hydration, and care must be taken during laryngoscopy to avoid mucosal injury and bleeding due to mucositis.[9]

UNDERSTANDING RADIOTHERAPY AND ITS IMPLICATIONS IN PERIOPERATIVE MANAGEMENT

Radiotherapy, often administered alongside or independently of chemotherapy, plays a significant role in cancer treatment. Perioperative anesthesiologists managing cancer surgeries must be aware that radiotherapy generates free oxygen radicals, which can lead to cellular damage. Radiation to the neck may cause skin induration and stiffness, potentially resulting in a challenging laryngoscopy and intubation.

Additionally, tissue damage caused by radiotherapy can impair postoperative wound healing. When combined with chemotherapy, radiotherapy increases the risk of complications such as myocarditis, pneumonitis, and pulmonary fibrosis.[10]

THROMBOSIS

Cancer patients face an elevated risk of venous thromboembolism (VTE), arterial thrombosis, and chronic disseminated intravascular coagulation. Cancer is a significant risk factor for VTE, alongside conditions such as obesity, prolonged immobilization, and hormone therapy. The risk of VTE increases substantially in obese cancer patients undergoing prolonged surgery and extended periods of inactivity. The incidence of VTE in cancer patients is approximately 0.5%, compared to 0.1% in those without cancer. Moreover, VTE is responsible for 20% of deaths in cancer patients, making it the second leading cause of mortality after cancer itself.[11]

Evidence from the Framingham Heart Study and the Global Anticoagulant Registry in the Field (GARFIELD)-VTE registry highlights that cancer-associated thrombosis (CAT) is linked to poorer survival rates among VTE patients.[11-13] Perioperative physicians and onco-anesthesiologists should be well-versed in the clinical implications, management, and treatment strategies for CAT.[11]

While the principles of managing CAT align with those for non-cancer-related VTE, the safety and efficacy of anticoagulant therapies differ between these groups. Cancer patients are at a higher risk of VTE recurrence (20.7% compared to 6.8% in non-cancer patients) and major bleeding complications (12.4% vs. 4.9% in non-cancer patients).[14]

AIRWAY MANAGEMENT

Head and neck cancer patients are often presumed to have a difficult airway due to the location and size of their tumors. Tumors that are fungating or bleeding, particularly those on the lips or cheeks, can complicate mask ventilation. Furthermore, prior neck radiation can cause restricted neck extension, making laryngoscopy and intubation challenging.

Anesthesiologists managing such cases must be adept at handling difficult airways and proficient in fiberoptic intubation techniques, especially for patients with oral cavity tumors or trismus. This expertise is essential to ensure safe and effective airway management in this high-risk population.[10]

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ANESTHETIC TECHNIQUE AND CANCER RECURRENCE

Cancer patients frequently undergo elective surgical procedures for diagnostic, curative, or palliative purposes. During these surgeries, circulating tumor cells can be released and disseminated, potentially increasing the risk of metastasis and recurrence. Cancer surgery, along with perioperative stress, anesthetics, and analgesics, can alter immune surveillance mechanisms and host defenses, potentially creating a pro-tumorigenic microenvironment.

Volatile anesthetic agents have demonstrated significant immunosuppressive effects compared to intravenous agents such as propofol, which has been shown to inhibit cancer cell activity. Opioids, meanwhile, suppress natural killer (NK) cell function and inhibit T and B lymphocyte activity through both direct and indirect mechanisms.[15-23]

The choice of anesthesia, analgesia, and anesthetic techniques is recognized to influence cancer outcomes. Thoracic epidural analgesia, often used in thoracic and upper abdominal surgeries, offers superior pain control, opioid-sparing benefits, and reduced inflammatory and adrenergic responses to circulating catecholamines, thereby minimizing postoperative immunosuppression.[24-25]

Research indicates that volatile anesthetics and opioid analgesics may be associated with reduced disease-free and overall survival after cancer surgeries. Conversely, in CRS-HIPEC procedures for high-volume appendiceal tumors, the use of volatile anesthetics with opioids has been linked to longer survival compared to total intravenous anesthesia (TIVA).[5,26]

Recent randomized trials in breast cancer surgeries, as well as thoracic, abdominal, and colorectal cancer procedures, have not demonstrated significant advantages of epidural or regional anesthesia over general anesthesia.[27-29] However, ongoing randomized controlled trials are expected to provide further insights into the influence of anesthetic techniques on cancer recurrence and progression.

USES OF OPIOIDS

Opioids are commonly used for managing preoperative pain in cancer patients and as postsurgical analgesia following cancer surgeries. However, their widespread and routine use has been reevaluated, particularly after the opioid crisis was declared in the United States in 2017 due to the misuse of these drugs.[30,31] While opioids remain essential for effective cancer pain management, prolonged or unnecessary use can lead to ORADEs.

In India, the use of opioids for managing both cancer and non-cancer pain remains limited. Many physicians lack formal training in pain management, and insufficient awareness about opioid-related policies further impede their prescription. The absence of clear guidelines on perioperative opioid usage and stringent regulatory restrictions on the medical use of opioids are significant barriers to their prescription.

Despite being one of the largest global producers of opioids, India has not experienced the issues of overuse commonly seen elsewhere. In fact, opioid consumption in India for pain management, including end-of-life care, remains relatively low and does not present a significant public health burden.[32-34]

Opioid Free Anesthesia/Opioid-sparing Anesthesia

Opioid-free anesthesia (OFA) refers to the complete exclusion of opioids in any form—systemic, neuraxial, or intracavitary—during the perioperative period. In contrast, opioid-sparing anesthesia (OSA) allows for the use of limited intravenous opioids intraoperatively. OFA has been associated with a reduction in the incidence of ORADEs, potentially leading to improved postoperative outcomes and supporting enhanced recovery programs.[35-37]

Some studies and laboratory data suggest that opioids might contribute to cancer recurrence and metastasis. Therefore, onco-anesthesiologists, in their role as perioperative physicians, should be well-versed in OFA techniques. They can incorporate locoregional anesthesia and utilize non-opioid medications such as gabapentinoids, alpha-2 agonists, N-methyl-D-aspartate (NMDA) antagonists, beta-blockers, paracetamol, and non-steroidal anti-inflammatory drugs (NSAIDs) as part of a multimodal analgesia approach. When applied judiciously, multimodal analgesia that combines opioid analgesics with non-opioid and regional techniques can provide superior postoperative pain relief while minimizing ORADEs.[38-42]

MANAGEMENT OF ACUTE POSTOPERATIVE PAIN

Cancer patients are increasingly receiving surgical treatment, contributing to longer lifespans. As the

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population ages, many cancer survivors will require redo surgeries or reconstructive procedures. Cancer surgeries often involve extensive resections and prolonged procedures, which demand effective postoperative pain management to reduce complications, shorten hospital stays, and lower overall treatment costs.

Uncontrolled acute postoperative pain can result in persistent pain and mood disturbances. Moreover, inadequate pain management in the postoperative phase may activate the sympathetic nervous system, increase inflammatory cytokines, and potentially promote tumor growth and metastasis. Therefore, managing acute postoperative pain effectively could, in theory, lead to better long-term survival outcomes. This suggests that onco-anesthesiologists may play a role in influencing cancer-related outcomes.[43-47]

ONCO-CRITICAL CARE

As cancer treatments continue to advance, more patients are living with cancer, and many of these individuals will require critical care at some point in their lives. Onco-anesthesiologists must be trained to manage patients in an oncologic ICU, as critical care is an essential component of modern cancer care, both for surgical and non-surgical patients.

While the principles of critical care remain consistent for both cancer and non-cancer patients, cancer patients present unique challenges. Issues such as venous thromboembolism (VTE), tumor lysis syndrome, febrile neutropenia, pancytopenia, superior vena cava syndrome, and hypercalcemia are common in the cancer population and necessitate specialized expertise in oncological critical care. This requires not only a deep understanding of critical care but also knowledge of oncology and palliative medicine.[48]

COMMUNICATION SKILLS

Communication skills are both cognitive and emotional abilities that physicians use to help patients and their families understand the nature and severity of cancer, treatment options, and make informed decisions about care. Effective communication between patients, onco-anesthesiologists, onco-intensivists, and their families is crucial for managing care in both hospital and ICU settings. Evidence suggests that several factors contribute to improving communication, including—the patient-physician relationship, handling medical information effectively, managing patient and family emotions, system-level communication, and educational interventions for physicians, patients, and their families.[49]

Delivering bad news is one of the most studied communication tasks in cancer care. Throughout the diagnosis and treatment process, patients and their families often experience a range of emotions, from fear and shock to sadness and eventual acceptance of the diagnosis.[50] Many cancer centers have established protocols for delivering bad news, but while it is important for physicians to be straightforward in communicating the diagnosis, they must also be sensitive and empathetic in their approach.[51-53]

MANAGEMENT OF CHRONIC PAIN AND PALLIATIVE CARE

Pain, particularly severe pain, is one of the most feared and distressing symptoms of cancer, affecting between 53 and 64% of cancer patients, with almost one-third experiencing moderate-to-severe pain.[54] Cancer pain is often multifactorial, arising from factors such as nerve or bone compression by the tumor, side effects of anticancer treatments, cancer-related debility, prolapsed intervertebral discs, osteoarthritis, or psychological causes triggered by the diagnosis.[55] Chronic pain following oncological surgery is also common, particularly after procedures such as thoracotomy, breast surgery, limb amputation, radical nephrectomy, neck dissection, and inguinal lymph node dissection. Post-thoracotomy and post-mastectomy pain are particularly prevalent, leading to ongoing physical, psychological, and emotional distress for patients, often lasting months or even years after surgery. Onco-surgeons, onco-anesthesiologists, and pain specialists should educate patients about the potential for chronic postsurgical pain and discuss treatment options and management plans.[56]

In addition to surgery, radiotherapy can cause painful conditions such as plexopathies, myelopathies, peripheral nerve entrapments, and more often manifesting months or even years after treatment. Radiation-induced brachial plexopathy and lumbosacral plexopathy are common, with a delayed onset that can range from 6 months to 30 years after radiotherapy. Onco-anesthesiologists need to be aware of these conditions and should be trained in managing chronic cancer-related pain.[56]

Palliative care, which is the fourth pillar of oncology alongside medical, radiation, and surgical care, should be discussed with patients from the point of diagnosis.

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Anesthesiologists play a key role in palliative care due to their expertise in medicine, anesthesia, sedation, and critical care. Integrating pain management and palliative care models requires that onco-anesthesiologists be well-versed in providing pain and palliative care to cancer patients.[57-61]

CAREER AND TRAINING IN ONCO-ANESTHESIOLOGY

Onco-anesthesiology is an emerging and rapidly growing specialty, offering diverse career opportunities. Many dedicated cancer centers and cancer wings within multispecialty hospitals now provide advanced training programs, including DM (Doctorate of Medicine) courses in onco-anesthesiology, as well as 2 years fellowships in onco-anesthesiology, pain management, palliative care, and perioperative medicine. The Society of Onco-Anesthesiology and Perioperative Care (SOAPC) offers a fellowship in onco-anesthesia and perioperative medicine.

Professionally trained onco-anesthesiologists have a wide range of job opportunities, including roles in dedicated cancer centers, national cancer centers, and hospitals affiliated with the National Cancer Grid. This expanding field underscores the growing recognition of the importance of specialized anesthetic and perioperative care in oncology.

CONCLUSION

In conclusion, onco-anesthesiology is a fast-growing specialty, driven by the increasing global burden of cancer. With approximately 19.3 million new cancer cases and nearly 10 million cancer-related deaths reported annually worldwide, advancements in diagnostic modalities and early detection have led to a significant rise in cancer diagnoses. This has resulted in more patients requiring cancer-specific surgeries and interventions. There is a growing need for trained onco-anesthesiologists, not only in the field of onco-anesthesiology but also in onco-critical care, acute and chronic cancer pain management, and palliative medicine, to provide comprehensive care for this expanding patient population.

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