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Review Paper

Anesthesia for bariatric surgery – Current practice

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ABSTRACT:
Bariatric surgery has emerged at the forefront as a promising procedure for severe obesity, offering sustained weight loss, reversal of metabolic disorders, and greatly aiding in improved life expectancy. However, the anesthetic management of bariatric patients presents unique challenges due to obesity-related comorbidities, such as cardiovascular disease, diabetes, respiratory dysfunction, and airway difficulties. A well-structured anesthetic plan is essential to optimize patient safety, minimize perioperative risks, and ensure smooth postoperative recovery. This review outlines current anesthetic practices for bariatric surgery, including preoperative assessment, airway management, intraoperative monitoring, pharmacological considerations, and postoperative care. A multidisciplinary approach, incorporating the latest advancements in anesthesia, enhances patient outcomes, reduces complications, and facilitates early recovery. By continuously updating anesthetic protocols, healthcare providers can improve the overall safety and success of bariatric procedures.

Keywords: Bariatric surgery, anesthesia, obesity

1. INTRODUCTION:

Obesity significantly impacts nearly every organ system, and it brings various complications, including an increased risk of coronary artery disease, high cholesterol, hypertension, diabetes, joint degeneration, gallbladder issues, and sleep apnea. In severe cases, it can bring both social and psychological challenges. Bariatric surgery has developed into a promising procedure for managing severe obesity, offering benefits like sustained weight loss, reversal of metabolic disorders, and increased life expectancy. With advancements leading to lower complication rates, the demand for bariatric procedures has grown substantially worldwide.

Adopting a multidisciplinary approach to bariatric surgery can help minimize complications, promote faster recovery, and reduce hospital stays. To achieve the best possible patient outcomes and maintain consistency in care, healthcare providers must continually stay updated with recent practices and protocols for the anesthetic management of bariatric surgery. This document presents current practices for anesthetic care, emphasizing patient safety, high-quality treatment, and improved surgical outcomes.

2. DEFINITION:

Bariatric surgery refers to a set of surgical interventions intended to treat obesity and its related health conditions. Long-term weight loss through bariatric surgery can be accomplished by modifying gut hormones, physically reducing the size of the stomach, decreasing nutrient absorption, or a combination of these mechanisms. Bariatric surgery requires specialized anesthesia care to ensure patient safety and achieve the best possible outcomes.

3. PATIENT GROUP:

Laparoscopic bariatric surgery is recommended for patients with a BMI ≥40 kg/m² or for those with a BMI between 35 and 40 kg/m² who have obesity-related comorbidities likely to improve with weight loss. Bariatric surgery can be considered as a treatment option for Type 2 Diabetes Mellitus in patients with class I obesity (BMI 30.0–34.9 kg/m²) whose hyperglycemia remains inadequately controlled despite optimal medical management[4]. The American Academy of Pediatrics and the American Society of Metabolic and Bariatric Surgery endorse metabolic and bariatric surgery (MBS) for children and adolescents with a BMI exceeding 120% of the 95th percentile (class II obesity) accompanied by significant comorbidity or a BMI above 140% of the 95th percentile (class III obesity)[28].

Table -1: IDENTIFICATION AND CLASSIFICATION OF OBESITY

Body mass index (BMI) should be used in adults. Obesity is defined as a BMI > 30 kg/m2. Morbid obesity refers to those with a BMI > 40 kg/m2[27].

	BMI
Normal range	18.5-25
Overweight	≥25
Pre-obese	25-30
Obese	≥30
Obese class I	30-35
Obese class II	35-40
Obese class III (morbidly obese)	≥40
Superobese	≥50
Supersuperobese	≥60

*Body Mass Index (BMI) - Weight in kg divided by the square of height in meters (kg/m2)

4. EXCLUSIONS:

Bariatric surgery has no absolute contraindications; however, there are several relative contraindications to consider. These include severe heart failure, unstable coronary artery disease, end-stage lung disease, active cancer treatment, portal hypertension, substance abuse issues, and significant cognitive impairments. Furthermore, Crohn's disease is a relative contraindication for Roux-en-Y gastric bypass surgery. Additionally, individuals with untreated or unresolved eating disorders or psychiatric conditions are typically not deemed suitable candidates for bariatric surgery. However, if these conditions are effectively treated or well-managed, and the individual obtains clearance from a psychologist, bariatric surgery may become a viable option.

5. PREOPERATIVE ASSESSMENT:

5.1 Medical History and Physical Examination:

Before undergoing bariatric surgery, a comprehensive evaluation and management of comorbidities like hypertension, diabetes, and obstructive sleep apnea are essential to ensure patient safety and achieve optimal outcomes. It is imperative to assess baseline cardiovascular and respiratory status. Patients need to stop smoking for at least four weeks and abstain from alcohol for one to two years before surgery. Preoperative fasting protocols recommend avoiding solid foods for six hours and clear liquids for two hours before surgery, provided there is no gastroparesis. These steps are critical to reducing surgical risks and promoting a smoother recovery.

5.2. Airway Management:

Patients undergoing bariatric surgery often present with difficult airways due to increased neck circumference, short neck, excess fat deposits around the upper airway, and reduced lung compliance, which can lead to challenges with intubation and ventilation. A detailed airway examination includes neck mobility, neck circumference, thyromental distance, and obstructive sleep apnea. In cases of anticipated difficult airway, advanced imaging techniques like ultrasound or CT scans should be used to gain a more detailed understanding of the airway anatomy.

5.3. Preoperative Testing:

- Baseline blood tests (complete blood count, electrolytes, glucose, liver function tests, renal function tests, thyroid function tests, lipid profile, coagulation tests).
- Arterial blood gas analysis if severe respiratory disease is present.
- ECG, Chest X-ray, Echocardiography, and stress tests as needed.
- Upper gastrointestinal (GI) endoscopy to evaluate the upper GI tract
- Pulmonary Function Test- Spirometry to identify obstructive or restrictive lung disease.

5.4.Medication Review:

Adjustments to medications are often required for safe perioperative management, including temporary discontinuation or dosage modifications based on their effects. Oral hypoglycemic agents should be stopped before surgery and switched over to regular insulin infusion. Anticoagulants and antiplatelet drugs must also be discontinued, following the guidance of a physician or cardiologist. Conversely, antihypertensive drugs, cardiac medications, and thyroid hormone replacements should generally be continued. For medications like GLP-1 receptor agonists, which can slow gastric emptying, the usual recommendation is to stop daily-dose drugs one day prior to surgery and weekly-dose drugs one week beforehand[25]. Gastric Point of Care Ultrasound is helpful to find delayed gastric emptying in these patients.

Table 2: Common GLP – 1 Agonists[25]

GLP-1 AGONISTS	CLINICAL DOSING	PHARMACOKINETICS		SPECIAL CONSIDERATIONS
		HALF-LIFE	ELIMINATION	
Semaglutide	SC, weekly, titrated Oral, daily, titrated	7 days	Renal	Approved (SC formation only) for weight loss
Liraglutide	SC, daily, titrated	12.5 hours	Renal	Approved for weight loss
Dulaglutide	SC, weekly	4.5 days	Renal	Approved for weight loss
Tirzepatide		5 days	Renal	Approved for weight loss

***SC - Subcutaneous**

5.5 . Screening for Obstructive Sleep Apnea (OSA):

Screening for obstructive sleep apnea (OSA) is a vital part of the preoperative evaluation for bariatric surgery patients, as OSA is highly prevalent in this group. Tools like the STOP-Bang questionnaire are frequently used to identify the likelihood of OSA by evaluating factors such as snoring, daytime sleepiness, and body mass index. Patients identified as high-risk through these screenings or clinical indicators may be referred for polysomnography (an overnight sleep study) to confirm the diagnosis and determine the severity of OSA. Patients diagnosed with OSA are treated with continuous positive airway pressure (CPAP) therapy for 3 months before surgery, which helps keep the airway open during sleep and reduces the risk of perioperative complications, including respiratory failure and cardiovascular instability.

5.6. Nutritional and Psychological Assessment:

Before surgery, a low-calorie or very low-calorie diet is often recommended to support preoperative weight loss. The specific amount of weight loss required varies and is determined by the bariatric surgeon based on the patient's health, weight, and the type of procedure being performed. In some cases, patients may need to lose 10% of their body weight, while for others, shedding 15 to 20 pounds just before surgery may be sufficient to lower the risk of complications. Additionally, prehabilitation exercises can enhance overall fitness and respiratory function, improving recovery outcomes after surgery.

Assessing and optimizing nutritional status is essential to ensure patients receive adequate nutrients before and after the procedure. This process often includes dietary counseling and supplements tailored to individual needs. Equally important is addressing psychological factors, such as concerns about body image, emotional eating habits, and anxiety related to the surgery, to promote better mental preparedness and long-term success.

6. Intra Operative Management:

6.1 Monitoring:

Standard monitoring includes continuous assessment of vital signs such as blood pressure, heart rate, oxygen saturation, end-tidal carbon dioxide, and temperature. In high-risk patients, additional invasive monitoring, such as an arterial line, may be utilized to closely monitor blood pressure and arterial blood gases throughout the procedure, providing real-time data to guide management decisions. BIS (bispectral index) monitoring is employed to assess the depth of anesthesia, helping anesthesiologists adjust anesthetic agents to maintain an appropriate level of sedation and prevent awareness during surgery. Neuromuscular monitoring ensures adequate muscle relaxation, which is essential for optimal surgical conditions and for preventing complications related to insufficient paralysis or residual neuromuscular blockade postoperatively.

6.2 Anesthetic Techniques:

General anesthesia is the anesthetic technique of choice in bariatric surgery, with Rapid Sequence Induction (RSI), especially in obese patients, to reduce the risk of aspiration. Anesthesiologists carefully adjust drug dosages based on lean body weight or adjusted body weight to account for pharmacokinetic differences due to fat distribution. General anesthesia can be delivered via Total Intravenous Anesthesia (TIVA) using Target Controlled Infusion (TCI) with Propofol and Remifentanil or through induction with Propofol and maintenance with Desflurane combined with short-acting opioids. When Propofol is used for maintenance, adjusted body weight is recommended for dosing calculations. However, TCI models become less accurate in patients with higher BMIs, so depth of anesthesia monitoring, such as the Bispectral Index (BIS), is necessary to ensure precise dosing.

Regional anesthesia techniques, including local anesthetic infiltration at the incision site or transversus abdominis plane (TAP) blocks, are often used as adjuncts to general anesthesia to enhance pain control.
Opioid-Free Anesthesia (OFA) is an emerging approach in bariatric surgery that focuses on minimizing opioid use to reduce side effects like respiratory depression, nausea, vomiting, and constipation. Instead of opioids, multimodal analgesia is employed to manage pain effectively. Multimodal analgesia includes the use of non-opioid medications such as acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), ketamine, lidocaine, and magnesium.

6.3 Ventilation Strategies:

Ventilation strategies are challenging in bariatric surgery for optimizing respiratory function and ensuring patient safety. Lung-protective ventilation practices involve using low tidal volumes, typically in the range of 6-8 ml/kg of ideal body weight, to prevent lung injury and maintain adequate gas exchange. Positive end-expiratory pressure (PEEP) is applied at levels between 5-10 cmH2O to maintain alveolar recruitment and improve oxygenation by preventing alveolar collapse during the respiratory cycle.

Anesthesiologists may employ either pressure control or volume control ventilation modes, often with an inverse respiratory ratio, to adapt ventilation to the patient's unique respiratory mechanics and surgical conditions. Alveolar recruitment maneuvers are utilized periodically to reopen collapsed or atelectatic lung areas, which can significantly improve intraoperative oxygenation, especially in obese patients with compromised pulmonary function. Continuous monitoring of end-tidal CO2 and periodic assessment of arterial blood gases are essential components of intraoperative care. End-tidal CO2 monitoring and flow volume loop analysis provides real-time feedback on ventilation adequacy and helps detect hypoventilation or airway obstruction promptly. Arterial blood gas analysis allows for precise oxygenation and acid-base balance monitoring, guiding adjustments to ventilation parameters as needed to maintain optimal respiratory status throughout the surgery.

6.4 Positioning:

Two standard operating room tables may be used together to accommodate massive patients, or specially designed tables can be employed. While conventional operating room tables typically support a maximum weight of 205 kg, some specially designed tables are wider and strong enough to hold patients weighing up to 455 kg[1]. Special care must be taken to protect pressure points, as pressure sores and nerve injuries are common, particularly in severely obese patients and those with diabetes.
The supine position can cause lung atelectasis and, a significant decrease in functional residual capacity (FRC), which leads to ventilation and perfusion mismatch. Additionally, abdominal weight may compress the inferior vena cava and aorta, impeding normal blood flow. The Trendelenburg position worsens these issues by further reducing lung volume, which can lead to cardiorespiratory failure. In contrast, the reverse Trendelenburg position is generally better tolerated and may improve respiratory function.
Sequential compression devices (SCDs) are to be applied in lower limbs during bariatric surgery to reduce the risk of deep vein thrombosis (DVT) and pulmonary embolism (PE). These devices intermittently compress the legs, promoting venous return and reducing the risk of thrombotic complications during and after surgery.

6.5 Pharmacology:

A multimodal approach to preventing postoperative nausea and vomiting (PONV) is standard practice, combining antiemetics such as serotonin antagonists and dexamethasone. Choosing short-acting anesthetics is crucial to expedite the emergence from anesthesia and promote quicker recovery times. Avoiding long-acting opioids helps mitigate respiratory depression and postoperative sedation, instead opting for multimodal analgesia. Intraoperatively deep neuromuscular blockade can facilitate surgical conditions by optimizing surgical exposure. Ensuring complete reversal of neuromuscular blockade post-surgery is critical to prevent residual paralysis and facilitate early recovery of respiratory function.
Dosing anesthesia drugs for morbidly obese patients requires careful consideration of their altered physiology and pharmacokinetics. The choice of dosing metric—**Total Body Weight (TBW)**, **Ideal Body Weight (IBW)**, or **Lean Body Weight (LBW)**—depends on the drug's properties and its distribution in the body. Lipophilic drugs, such as Propofol and fentanyl, often require dosing based on TBW due to their larger volume of distribution in fat tissue. Hydrophilic drugs, like muscle relaxants (e.g., rocuronium), are better dosed using IBW or LBW to avoid overdosing, as they primarily act in lean tissues. Drugs with rapid metabolism and minimal tissue storage, such as remifentanil, are typically dosed using IBW to ensure safety and efficacy[26]. This tailored approach minimizes the risks of underdosing or toxicity while ensuring effective anesthesia management.

Table. 3: Common anesthesia drugs for morbidly obese patients based on Total Body Weight (TBW), Ideal Body Weight (IBW), and Lean Body Weight (LBW)[26]:

Drug Class	Drug	Weight Metric for Dosing	Comments
Induction Agents	Propofol	Induction: LBW or TBW Maintenance: TBW	Lipophilic; larger doses for induction due to increased distribution volume.
	Etomidate	TBW	Minimal fat solubility; dosing based on TBW is sufficient.
	Ketamine	TBW	Lipophilic; dose based on TBW to achieve adequate effect.
Inhalational Agents	Sevoflurane/Desflurane	No adjustment needed	Uptake depends on pulmonary factors, not weight.
Opioids	Fentanyl	Loading: TBW Maintenance: LBW or IBW	Lipophilic; risk of accumulation with repeated dosing.
	Remifentanil	IBW	Rapid metabolism; minimal accumulation.
Muscle Relaxants	Succinylcholine	TBW	Increased pseudocholinesterase activity in obesity.
	Rocuronium/Vecuronium	Loading: IBW Maintenance: IBW or ABW	Adjusted for volume of distribution and receptor availability.
Reversal Agents	Neostigmine	IBW	Avoid overdose; adjust to prevent excessive cholinergic effects.
	Sugammadex	TBW	High efficacy even with TBW-based dosing.
Local Anesthetics	Lidocaine/Bupivacaine	IBW	Reduces risk of systemic toxicity.

6.6 Fluid Management:

A tailored approach to fluid administration begins with a thorough assessment of the patient's preoperative hydration status, comorbidities, and anticipated fluid losses during surgery. To guide fluid administration, goal-directed fluid therapy utilizes dynamic parameters such as stroke volume variation, pulse pressure variation, or arterial waveform analysis. Crystalloids, such as balanced electrolyte solutions (e.g., Ringer's lactate or Plasma-Lyte), are typically the first-line choice for fluid resuscitation and maintenance due to their safety profile and ability to correct electrolyte imbalances. Colloids like albumin or synthetic colloids may be considered in situations requiring rapid volume expansion or in patients with hypoalbuminemia. However, their use is generally limited and closely monitored due to potential risks of coagulopathy and renal dysfunction. Maintaining euvolemia and avoiding fluid overload is paramount to preventing complications such as pulmonary edema, impaired wound healing, and renal impairment.

6.7 Temperature Control:

Core temperature monitoring is typically prioritized using esophageal probes, tympanic thermometers, or bladder temperature sensors. These devices provide accurate readings of internal body temperature, guiding anesthesia providers in maintaining normothermia throughout the procedure. In addition to core temperature monitoring, peripheral temperature measurements using infrared thermometers or skin probes offer supplementary information about overall thermal status. To prevent hypothermia, intraoperative strategies include using forced air warming systems, which circulate warm air around the patient. Pre-warmed blankets and warmed intravenous fluids also contribute to maintaining body temperature stability.

7. Postoperative Management:

7.1 Pain Control:

A multimodal approach forms the cornerstone of pain management strategies, combining different classes of medications to achieve optimal pain relief while minimizing opioid use and its associated side effects. Non-opioid analgesics like acetaminophen and

NSAIDs are commonly used to manage mild to moderate pain. Regional anesthesia techniques, such as the Transversus Abdominis Plane (TAP) block and local anesthetic infiltration at the incision site, play a significant role in providing targeted pain relief directly to the surgical site.

7.2 Respiratory Support:

Patients are generally extubated in semi-sitting positions when they are fully awake and have regained protective reflexes. This practice reduces the risk of aspiration and respiratory complications associated with residual sedation or impaired airway reflexes post-anesthesia. In cases where upper airway obstruction is a concern, nasopharyngeal airways may be utilized to maintain airway patency and facilitate effective breathing. CO2 monitoring can be done in spontaneously breathing patients using nasal prongs, which can administer oxygen and simultaneously measure End-tidal CO2 (ETCO2) and display Capnograph and respiratory rate. Continuous CO2 monitoring helps early detection of hypoventilation indicated by hypercapnia and reduced respiratory rate. By identifying rising CO2 levels promptly, healthcare providers can intervene early to prevent severe respiratory depression and subsequent complications like hypoxia, which can be particularly dangerous in this patient population. Continuous monitoring of respiratory status is essential, particularly in patients with obstructive sleep apnea (OSA). Bilevel positive airway pressure (BiPAP) or Continuous positive airway pressure (CPAP) devices may support ventilation and prevent airway collapse in patients with known or suspected OSA. Early mobilization and incentive spirometry are encouraged to promote optimal lung function and prevent atelectasis.

7.3 Monitoring:

All patients post bariatric surgery require careful monitoring of vital signs, respiratory function, **and** obstructive sleep apnea. High-risk patients may require close monitoring in a high-dependency or intensive care setting immediately following surgery. This level of monitoring allows healthcare providers to closely observe vital signs, oxygen saturation, and overall clinical status, providing prompt intervention if necessary. Additionally, vigilant surveillance for deep vein thrombosis (DVT) and pulmonary embolism (PE) is essential due to the increased risk associated with obesity and prolonged surgical procedures.

7.4. Nausea and Vomiting:

The reasons for postoperative nausea and vomiting (PONV) are multi factorial in this population, including anesthesia effects, altered gastrointestinal anatomy, and medication use. Preventative measures start intraoperatively with administering antiemetics, such as serotonin antagonists (e.g., ondansetron) and dexamethasone, to mitigate the emetogenic effects of anesthesia and surgery. In cases where nausea and vomiting occur despite preventive measures, prompt administration of rescue antiemetics such as metoclopramide or promethazine can provide relief. Ensuring adequate hydration and managing electrolyte imbalances are important considerations, particularly in patients at risk for dehydration due to reduced oral intake post-surgery.

8. PACU discharge:

Patients undergoing bariatric surgery are considered for discharge from the Post-Anesthesia Care Unit (PACU) once they meet standard discharge criteria, with additional attention to maintaining stable oxygen saturation (SpO2) levels comparable to preoperative baseline. This requirement includes ensuring that SpO2 remains adequate without excessive oxygen support and signs of hypoventilation. Hypoventilation, which can indicate respiratory depression or inadequate ventilation, is closely monitored to prevent complications post-surgery. In addition to respiratory stability, other typical discharge criteria from PACU include recovery from anesthesia with alertness and orientation, stable vital signs within normal limits, effective pain management, adequate fluid balance, minimal nausea and vomiting, and adequate fluid balance. Patients should also demonstrate readiness for mobility and ambulation, which is essential for transitioning to a lower level of care.

9. Venous Thromboembolism (VTE) Prophylaxis:

Mechanical prophylaxis involves using graduated compression stockings or sequential compression devices (SCDs to promote venous return and reduce stasis in the lower extremities. These stockings exert graduated pressure, highest at the ankle and decreasing upwards, which helps prevent deep vein thrombosis (DVT) by enhancing blood flow and preventing venous pooling.

Pharmacological prophylaxis commonly involves the administration of low molecular weight heparin (LMWH), such as enoxaparin or dalteparin. LMWHs inhibit thrombin formation and prevent clot formation, reducing the risk of DVT and pulmonary embolism (PE).

10. Education and Discharge Planning:

Patients should be educated in detail about dietary modifications, starting with a clear liquid diet and gradually progressing to solid foods, along with the importance of small, frequent meals and necessary lifelong vitamin and mineral supplementation. Patients need to maintain adequate hydration, and fluids should be avoided with meals. Patients should be educated on the gradual increase in physical activity, beginning with light activities like walking and building up over time. Wound care, including signs of infection and medication management, must be clearly explained.

Scheduled follow-up appointments with the surgeon, dietitian, and primary care physician are essential for ongoing monitoring. Providing emergency contact information, encouraging participation in support groups, and offering mental health resources are also important. Patients must be educated about the necessity of long-term lifestyle changes, including healthy eating and regular exercise, and should set realistic weight loss and body image expectations.

11. Special Considerations:

- Emergency Preparedness.
- Ensure readiness for emergencies, including difficult airway management and cardiovascular complications.
- Multidisciplinary Approach.
- Collaboration with a multidisciplinary team, including surgeons, dietitians, and physiotherapists, to optimize patient outcomes.

12. OTHER HEALTHCARE PROVIDER'S ROLE:

The outcome of bariatric surgery depends on a multidisciplinary team of healthcare providers, each contributing to the patient's journey from preoperative assessment to postoperative care and long-term follow-up. The surgeon evaluates the patient's suitability, performs the surgery, and monitors recovery. Dietitians and nutritionists guide dietary changes before and after surgery, ensuring proper nutrition and supplementation. Psychologists assess mental health, offer preoperative clearance, and provide ongoing emotional support. Nurses educate on preoperative preparations, assist during surgery, and manage postoperative care. Each team member's role is crucial in ensuring comprehensive care and maximizing long-term success.

13. PATIENT ROLE:

Patients must undergo comprehensive medical evaluations, including nutritional, psychological, and physical assessments, to determine their suitability for surgery. Patients are often required to prepare for surgery, such as adopting a healthier diet, starting exercises regularly, and quitting smoking or reducing alcohol consumption. Few patients need to lose weight before surgery to reduce surgical risks. Patients must follow specific preoperative instructions, including fasting, taking prescribed medications, and attending all appointments before surgery. Patients need to follow detailed postoperative care instructions, which include wound care, pain management, and recognizing signs of complications. Patients should attend regular follow-up appointments with the bariatric team, including the surgeon, dietitian, and psychologist, to monitor progress and address any concerns. Patients should commit to long-term lifestyle changes, including maintaining a balanced diet, regular exercise, and ongoing mental health support.

14. ABBREVIATIONS:

ABW : Adjusted body weight
ASA: American Society of Anesthesiologists
ERAS: Enhanced Recovery After Surgery Society
BMI: Body Mass Index
CPAP: Continuous Positive Airway Pressure
GLP : Glucagon Like Peptide
IBW : Ideal body weight
LBW : Lean body weight
OSA : Obstructive Sleep Apnea
MBS: Metabolic and Bariatric Surgery
SOBA: Society for Obesity and Bariatric Surgery
TBW : Total body weight
TAP block: Transversus Abdominis Plane block
PACU: Post Anesthesia Care Unit
BIS : Bispectral Index
RSI : Rapid Sequence Induction
DVT : Deep Vein Thrombosis

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