

Liposuction Anaesthesia: Considerations and Techniques

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Abstract

This study aimed at recognizing the ultimate decision to select the type of anesthesia depends on the type and extent of the liposuction surgery planned, the patient's underlying health condition and the psychological disposition of the patient. The study also describes the four types of liposuction techniques based on the volume of infiltration or wetting solution injected, dry, wet, superwet, and tumescent technique. Besides analyzing the main differences between these techniques and the amount of infiltration done into the tissues and the resultant blood loss as a percentage of aspirated fluid, highlighting that the tumescent technique is the most common of all liposuction techniques. The study found that liposuction is a popular procedure for reducing excessive fat from the body. It is associated with major hemodynamic changes, especially in large-volume liposuction surgery. Anaesthesia for these procedures requires a thorough understanding of the physiological changes and likely complications associated with them.

Keywords: Anaesthesia, liposuction, techniques.

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1.1 Introduction

Plastic surgery of the abdomen increasing demand has also increased the number of complications, some of them very difficult to manage. Increased awareness about cosmetic surgery has made liposuction a popular plastic surgical operation. Liposuction is defined as removal of fat from deposits beneath the skin using a cannula with the assistance of a powerful vacuum. In Jordan, more than 3600 liposuction procedures were performed in 2016 (Jordan Times, 2017).

However, there have been reports of adverse outcomes, so the anaesthesiologist should understand the pathophysiology of obesity and fluid management during liposuction and be aware of the complications. In Jordan, though statistics are not available but the popularity of this procedure is on the rise. A variety of liposuction procedures are being conducted on a regular basis, which vary from small volume liposuction of the arms to very large volume liposuction procedures of the abdomen and thighs (Lehnhardt, Homann, Daigelev,

Hauser, Palka & Steinau, 2008).

Liposuction was started in the 1970s in Italy. Here, fat evacuation was done with a limit curette. This method was altered in 1977 by a French specialist, Yves Gerard Illouz, who added hyaluronidase and saline to emulsify the greasy tissue, and subsequently encourage yearning with the utilization of liposuction cannula. This was named the 'wet technique' and was introduced to reduce blood loss during the procedure (Sood, Jayaraman & Sethi, 2011).

Liposuction is a standout amongst the most prevalent treatment modalities in aesthetic surgery with certain one of a kind anaesthetic contemplations. Liposuction is regularly executed as an office procedure. Liposuction has nowadays become a popular procedure amongst all age groups. Because of the advances in the field of Plastic Surgery and Anesthesia, it is now a fast and safe surgery and delivers good results. But Anesthesiologists must be very accurate when they are involved in such cases. What an Anesthesiologist must always remember is that the most of the times, the person undergoing liposuction is not a patient. It's a cosmetic procedure (Nair, Sriprakash, Nirale & Balasubramanyam, 2013).

Liposuction is the commonest aesthetic procedure performed in Jordan, as the combination of rich food, sedentary lifestyle and a peculiar body habitus predisposes the Jordanian population to accumulation of significant fat deposits. In addition, fascination for minimally invasive procedures and reluctance for scars make liposuction the procedure of choice for body contouring in Jordanian patients (Methil, 2015).

Although the subject makes a lot of people nervous, anesthesia is necessary for a smooth operation and proper recovery. Different types of anesthesia not only provide pain relief and keep the patient still, but help control the natural reactions of the body to pain or trauma.

Anesthesia works as an analgesic (pain reliever), as an amnesiac (loss of memory), by creating unconsciousness, by immobilizing you, and by stopping or reducing automatic responses such as increased heartbeat, rapid breathing, and a rise in blood pressure. The obstruction of sensory, reflex, mental and motor functions are needed to safely and effectively operate on a patient. These factors are what make surgery possible (Hall, 2012).

Although there are several types of anesthesia, not all surgeons will offer every one and not all are applicable to every type of surgery, or more specifically, to liposuction. There are basically four types of anesthesia: local, regional, conscious sedation, and general. Liposuction is generally performed using either general anesthesia or local anesthesia. The choice depends on the surgeon's preferences and on how large an area are having treated. Local anesthesia numbs a small area and is most commonly used during smaller plastic surgical procedures. (Allman, Wilson & O'Donnell, 2016).

1.2 Problem statement

Anesthesia could be divided into four categories: local anesthesia, local anesthesia combined with sedation, regional anesthesia and general anesthesia (Bennett, 2005). The problem statement of this study lies in the dilemma of the ultimate decision to select the type of anesthesia depends on the type and extent of the liposuction surgery planned, the patient's underlying health condition and the psychological disposition of the patient.

Hence, the four types of liposuction techniques, as shown in table (1), will be described based on the volume of infiltration or wetting solution injected, dry, wet, superwet, and tumescent technique (Sood, Jayaraman & Sethi,

2011). Therefore, the second aim of this study is to analyze the main differences between these techniques and the amount of infiltration done into the tissues and the resultant blood loss as a percentage of aspirated fluid, highlighting that the tumescent technique is the most common of all liposuction techniques.

Table (1): Types of liposuction techniques

Dry technique	The aspiration cannula is inserted directly into the space from which fat is to be removed, with no infiltration of the tissues. The estimated blood loss is 20-45% of the aspirated volume
Wet technique	Regardless of the amount aspirated, 200-300 ml of wetting solution is injected per area to be treated. Blood loss is approximately 4-30% of the aspirated volume
Superwet technique	The amount of fluid injected (1 ml per estimated milliliter of expected aspirate) is equal to the amount of fat to be removed. Blood loss is approximately 1% of the aspirated volume
Tumescent technique	Large volume of fluid (3-4 ml per estimated milliliter of expected aspirate) is injected into the fat, raising the concerned areas to become turgid and firm. Blood loss is approximately 1% of the aspirated volume

1.3 Historical background of anaesthesia

Of all turning points and accomplishments in medicine, vanquishing pain must be one of the very few that has conceivably influenced each person on the planet. It was in 1846 that one of humanity's biggest fears, the pain of surgery, was disposed of. This historical review depicts how the different components of anesthesiology (gasses, laryngoscopes, endotracheal tubes, intravenous medications, masks, and delivery systems) were found and how some splendid business of entrepreneurs and physicians of the previous two centuries have conveyed them to humankind.

One name stands out amongst all others when the founder of modern anesthesia is discussed, William T.G. Morton (1819-1868). A young Boston Dentist, Dr. Morton had been in the search for a better agent than what had been used by many dentists: nitrous oxide. With Dr. Morton's tenacity driven by enthusiasm and discovery, he and renowned surgeon at Massachusetts General Hospital, John Collins Warren (1778-1856) made history on October 16, 1846 with the first successful surgical procedure performed with anesthesia. Dr. Morton had single-handedly proven to the world that ether is a gas that when inhaled in the proper dose, provided safe and effective anesthesia. One of the first accounts of an endotracheal tube being used for an airway comes from the pediatrician Joseph O'Dwyer (1841-1898). He used the metal "O'dwyer" tubes in diphtheria cases and passed them into the trachea blindly. Adding a cuff to the tube is credited to Arthur Guedel (1883-1956) and Ralph M. Waters (1883-1979) in 1932. This addition suddenly gave the practitioner the ability to provide positive pressure ventilation.

The anesthesiologist Chevalier Jackson (1865-1958) promoted his handheld laryngoscope for the insertion of endotracheal tubes and its popularity quickly caught hold. Sir Robert Reynolds Macintosh's (1897-1989) breakthrough technique of direct laryngoscopy came after being appointed Nuffield professor of anesthetics at the University of Oxford in 1937. He was the first to describe the routinely placing of the tip of his newly re-designed laryngoscope in the epiglottic vallecula which is attached to the base of the tongue, thus when lifted exposed the entire larynx. Macintosh was genuinely astonished at what a great view he could achieve with his new blade and technique. The use of barbiturates as an intravenous anesthetic began in 1932. Sodium thiopental

gained popularity after its use was described in detail by a Dr. John Lundy (1894-1973) of the Mayo Clinic. Other I.V. medications were tried over the past seventy years, but the newest induction drug which provided for a substantially shorter recovery period and seemed to actually suppress laryngeal reflexes has brought with it many benefits. Propofol, introduced clinically in 1977, demonstrated many positive effects even as an anti-emetic compound. Before October of 1846, surgery and pain were synonymous but not thereafter. As we entered the information age where the infrastructure of evidence based medicine and newer fields of genetics, transplantation, imaging radiology and even stem cells became quickly integrated into mainstream medicine, we can predict an excellent future on the progress to be made in anesthesia (Robinson & Toledo, 2012).

1.4 Historical background of liposuction

The roots of liposuction can be traced back as far as the 1920s when French surgeon Charles Dujarier first introduced the concept of body contouring and fat removal. However, after a procedure performed by Dujarier caused gangrene in the leg of model, interest in the concept of body contouring was lost in the decades following.

Interest in liposuction was reignited after European surgeons used primitive curettage techniques, although these were also eventually ignored due to the inconsistency of results. It was in 1974 that doctors Arpad and Giorgio Fischer working in Rome, Italy, developed the blunt tunnelling technique from which modern liposuction evolved.

Liposuction became popular in 1982 when a French surgeon called Dr Yves-Gerard Illouz presented the “Illouz Method,” which demonstrated a suction-assisted method for removing fat cells. Yves-Gerard used cannulas to inject fluid into tissue to break up the fat deposits which were removed using the suction device. The results of this technique demonstrated high reproducibility and were associated with low morbidity.

Following this, another surgeon called Pierre Fournier, introduced the use of lidocaine as a local anesthetic, as well as modifying the surgical incision method and using compression techniques after surgery. In the 1980s, American physicians started to experiment with the technique and developed various sedation methods that eliminated the need for general anesthesia.

Towards the end of the 1990s, doctors introduced the use of ultrasound for liquefying fat so that it could be removed more easily. Developments such as this have led to improvements in the liposuction technique over the decades that mean fat can now be removed more easily and with less pain, blood loss and other associated complications (Shiffman, 1997).

1.5 Types of anaesthesia in liposuction

Anesthesia is the use of medicine to prevent the feeling of pain or another sensation during surgery or other procedures that might be painful. Given as an injection or through inhaled gases or vapors, different types of anesthesia affect the nervous system in various ways by blocking nerve impulses and, therefore, pain. The choice of anesthesia technique for liposuction varies based on multiple factors: surgeon and anesthesiologist preferences, patient comorbidities, patient positioning, anatomical areas being treated, type of liposuction being performed, amount of expected lipoaspirate, length and extent of procedure and volume of liposuction planned (Alan & Steven, 2003).

Descriptions of local anesthesia, various forms of sedation (mild, moderate, heavy) and general anesthesia are present in the literature. Small-volume liposuction cases can be performed with local anesthesia, with or without

mild sedation. Complex, large-volume liposuction and combined cases should be performed under general anesthesia. Deep sedation cases and general anesthesia procedures are performed under supervision of board-certified anesthesiologists in licensed surgery centers or hospitals (Mann, Palm & Sengelmann, 2008).

The monitored anesthesia care is a useful technique for small volume liposuction. Infiltration with vasoconstrictor and local anesthetic reduces bleeding and provides intraoperative analgesia, respectively. Thus, it allows liposuction to be performed under light sedation, implying a short recovery time, earlier discharge, and low cost to the patient. However, if infiltration is not uniform, some areas will have a lack of analgesia, thus requiring more sedation (Sood, Jayaraman & Sethi, 2011).

Sedation with midazolam (1-3 mg) and analgesia with fentanyl (25-50 mg) or remifentanyl (12.5-25 mg) is commonly employed for small volume liposuction. Propofol (0.5-1 mg/kg) may be given intermittently for monitored anaesthesia care. Ketamine in low doses (0.25-0.5 mg/kg) along with midazolam decreases significantly the consumption of opioids in the intraoperative period and of analgesics in the postoperative period. Clonidine 2-5 mg/kg, is also a useful adjuvant in sedation techniques.

The lumbar epidural anesthesia is widely used to provide analgesia in abdominal liposuction. The quality of analgesia provided is superior to that provided by local infiltration. Epidural anesthesia is associated with a lot of minor side effects, easy to prevent and to manage and that commonly do not raise safety concerns. However, an extensive epidural blockade is frequently associated with hypotension and must be limited to patients with good cardiac reserve (Beaussier, 2010).

Spinal anaesthesia, as shown in figure (1), (also called subarachnoid block) is preferred as bulk of fat to be sucked out is situated in lower half of the torso (below the umbilical area) and the duration of surgery is about three hours. This covers the subcostal areas as well and further reduces the need of lidocaine in the infiltrating solution as general anaesthesia is avoided. A 27 gauge needle (figure 2) avoids the often troublesome post spinal anaesthesia headaches. Fentanyl is additionally added to the high spinal because it has a bupivacaine sparing effect on spinal anaesthesia.

The quality of anaesthesia and muscular relaxation is excellent and administration of opioids in the subarachnoid space provides good analgesia in the first 24 hours of the postoperative period. In these conditions, this technique is safe, low cost, and with few side effects (Lakshyajit, 2008).

There are two reasons why infiltration with local anesthesia has traditionally been limited to relatively small areas of skin:

- 1- The stinging pain associated with infiltrating the local anesthesia is not easily tolerated.
- 2- Published dosage limitations have precluded anesthetizing large areas of skin.

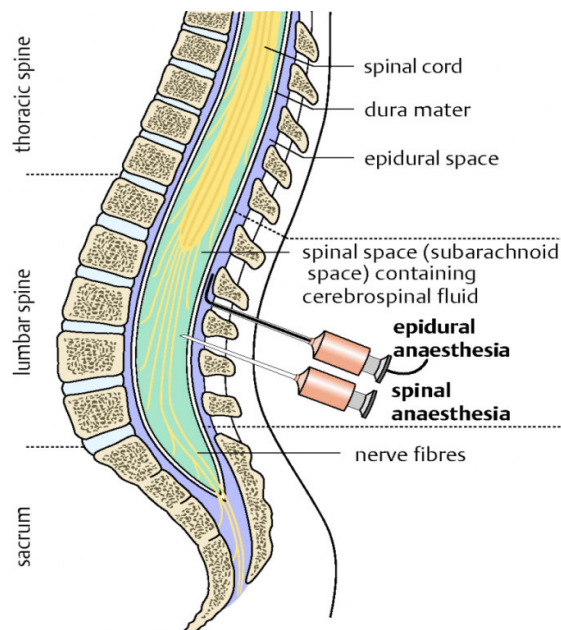


Figure (1): Spinal anaesthesia

These limitations have now been overcome with the recognition that:

- 1- Adding sodium bicarbonate in order to neutralize the acidity of commercially available local anaesthesia solutions of lidocaine and epinephrine dramatically reduces the usual burning-stinging pain of infiltration.
- 2- Using dilute solutions of lidocaine with the tumescent technique permits profound anaesthesia of very large areas (Klein, 1990).

The tumescent technique (detailed later) involves the subcutaneous infiltration of very large volumes of dilute local anaesthetic solution (usually containing adrenaline), until the tissues become tense and swollen. This technique permits regional local anaesthesia of skin and subcutaneous tissue by direct infiltration rather than by proximal nerve block or even general anaesthesia, without IV sedation or narcotic analgesia.

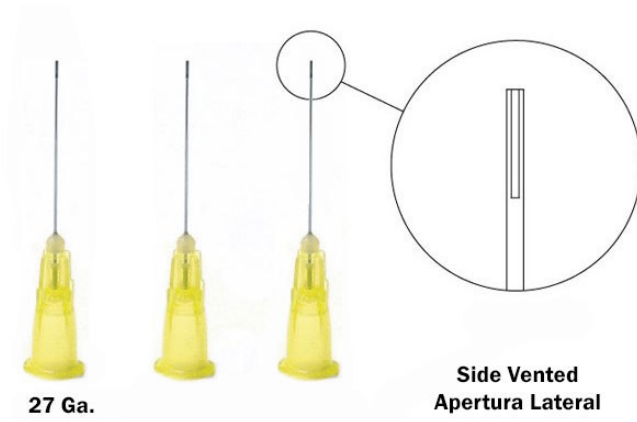


Figure (2): A 27 gauge needle

The tumescent anesthesia associated with unconscious sedation, has been demonstrated to be a safe technique, without major complications, with lower operative time, quick recovery and good satisfaction in a large number of outpatients. Decreased operative time moreover reduces risk of thromboembolic phenomenon, heat loss, and the anaesthetic solution exposure time, with lower absorption risk (Fasciolo & Maioli, 2010).

Data from the few anesthesia studies that have specifically assessed patients undergoing liposuction confirm the safety of general anesthesia, epidural anesthesia, spinal anesthesia, moderate sedation, and local anesthesia for this procedure. It should be noted, however, that epidural anesthesia and spinal anesthesia can cause vasodilation and hypotension, thereby necessitating the administration of excess fluid and increasing the risk for fluid overload (Haeck, Swanson, Gutowski, Basu & Wandel, 2009).

Although no evidence supports the use of any single technique, the American Society of Plastic Surgeons Practice Advisory recommends avoiding neuraxial anesthesia (i.e., spinal, epidural) in office-based settings because of potential hypotension and volume overload issues; therefore its use must be reserved for the operation room. Also, a moderate sedation/analgesia (intravenous or oral) augment the patient's comfort level and is an effective adjunct to anesthetic infiltrate solutions (Iverson & Lynch, 2004).

1.6 Anaesthesia Techniques

No single anaesthesia technique has been proven to be superior over another, thus liposuction may be performed under local, regional, or general anaesthesia.. The technique of anaesthesia depends on both, the site and extent of liposuction and also patient preference. The anaesthetic technique will vary according to the areas being operated upon; arms, thighs, abdomen, or buttocks, as shown in figure (3), and the volume of liposuction, as shown in figure (4), being performed. Since these procedures are often performed as day care, it is important that there is fast recovery of psychomotor and cognitive functions ensuring early discharge of the patients.

1.6.1 Monitored anaesthesia care

This is a useful technique for small volume liposuction. Infiltration with vasoconstrictor and local anaesthetic reduces bleeding and provides intraoperative analgesia, respectively. Thus, it allows liposuction to be performed under light sedation, implying a short recovery time, earlier discharge, and low cost to the patient. However, if infiltration is not uniform, some areas will have a lack of analgesia, thus requiring more sedation. Sedation with midazolam (1-3 mg) and analgesia with fentanyl (25-50 mg) or remifentanyl (12.5-25 mg) is commonly employed for small volume liposuction. Propofol (0.5-1 mg/kg) may be given intermittently for monitored anaesthesia care. Ketamine in low doses (0.25-0.5 mg/kg) along with midazolam decreases significantly the consumption of opioids in the intraoperative period and of analgesics in the postoperative period. Clonidine 2-5 mg/kg, is also a useful adjuvant in sedation techniques (Bauer, Dom, Ramirez & O'Flaherty, 2004).

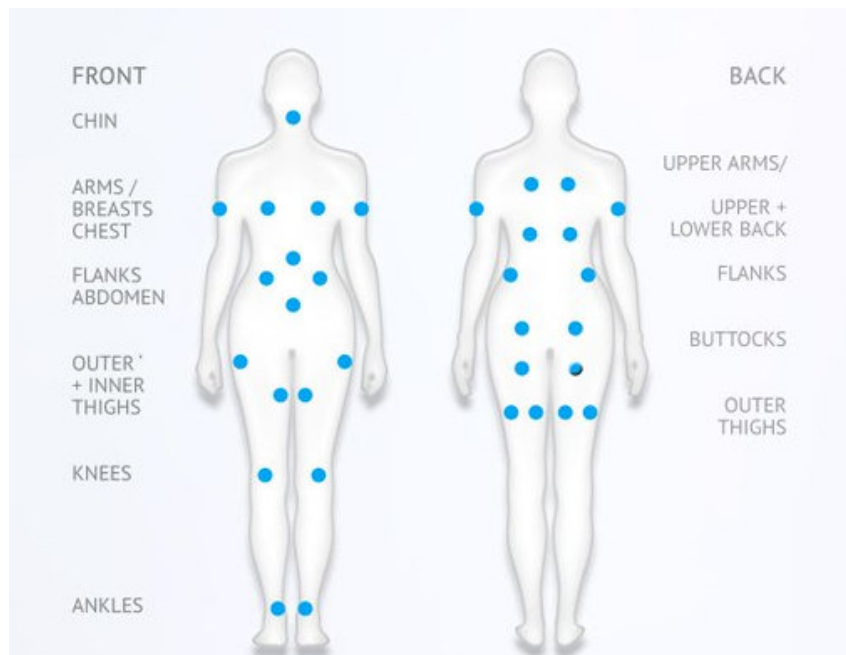


Figure (3): Liposuction sites



Figure (4): Liposuction volume

1.6.2 Lumbar epidural anaesthesia

This is widely used to provide analgesia in abdominal liposuction. The quality of analgesia provided is superior to that provided by local infiltration. However, an extensive epidural blockade is frequently associated with hypotension and must be limited to patients with good cardiac reserve (Knize & Fishell, 1997).

1.6.3 Subarachnoid block

This is a useful technique for liposuction below the umbilical area. In these conditions, this technique is safe, low cost, and with few side effects. The quality of anaesthesia and muscular relaxation is excellent and administration of opioids in the subarachnoid space provides good analgesia in the first 24 hours of the postoperative period (Regatieri & Masquera, 2006).

1.6.4 General anaesthesia

This is recommended for large volume liposuction or if the patient desires it. Propofol is the induction agent of choice because of its pharmacokinetic profile and inherent antiemetic property, which ensures early recovery of

the patient.[38] Airway can be maintained with a supraglottic device laryngeal mask airway, proseal LMA (PLMA) or I-gel. Muscle relaxation may be achieved with a nondepolarizing drug – atracurium, rocuronium, or vecuronium. Analgesia is provided by short-acting opioids such as fentanyl or remifentanyl and infiltration of lignocaine in the subcutaneous tissue.

1.6.5 Patient positioning

The usual position for surgery is supine. However, the position varies according to the area to be operated upon. Liposuction of buttocks and back of the thighs requires prone position. Appropriate precautions should be taken to prevent pressure injuries by carefully padding the sensitive pressure points – face, breasts, iliac crest, and knees in the prone position, and elbows and heels in the supine position. Care should be taken to avoid pressure on the brachial plexus and ulnar nerve. Protection of eyes with lubrication and padding and placing the head on a Gel Horseshoe Headrest is essential. Pneumatic compression devices are used for large-volume liposuction and for procedures lasting more than an hour, to prevent deep vein thrombosis (DVT) (Habbema, 2010).

1.6.6 Monitoring

For small volume liposuction, standard ASA monitoring such as oxygen saturation (SpO₂), noninvasive blood pressure (NIBP), end-tidal carbon dioxide (EtCO₂), electrocardiogram (ECG), and temperature monitoring suffice. Invasive monitoring such as central venous pressure and arterial blood pressure are required for large volume liposuction. Monitoring hourly urine output is important to indicate the fluid homeostasis in the body. Grazer et al. have recommended overnight continuous monitoring in patients undergoing large volume liposuction (Grazer & De Jong, 2000).

1.6.7 Intraoperative fluid administration

The intraoperative fluid maintenance in these patients is different from other surgeries. The aim of intravenous fluid administration is to replace the preoperative deficit and provide maintenance fluid. In these procedures after induction of anaesthesia, wetting solution is injected into the areas where liposuction is to be done. The total fluids received by the patient include intravenous fluids and the volume of wetting solution injected. The output includes the urine output and the aspirated fluid which includes fat, blood, and a portion of wetting solution. The difference between the fluid input and output is the residual volume that remains in the patient. The majority of this residual volume comprises of wetting solution, which remains in the extravascular compartment. This fluid, which acts like an interstitial infusion, slowly gets absorbed into the intravascular compartment. Thus, any excess fluid administered can easily produce fluid overload, which is an important cause for morbidity in these patients (Sommer, 2001).

1.7 Postoperative care

Monitoring should continue in the postoperative period for large-volume liposuction.

1.7.1 Pain relief

Since pre-emptive analgesia is provided by the local anaesthetic in tumescent liposuction, the requirement of analgesics in the intraoperative and postoperative period is minimal. By adding epinephrine to lignocaine, the duration of analgesia obtained from tumescent lignocaine can be extended by many hours. Non-Steroidal Anti-inflammatory Drugs (NSAIDs) may also be prescribed for postoperative pain relief.

1.7.2 Early ambulation

Patients are asked to begin ambulation as soon as possible and lower extremity muscle-contracting exercises are

to be encouraged, while they are in bed to minimize the risk of DVT and pulmonary embolus.

1.7.3 Complications

Liposuction, although done very often as a day care procedure has been associated with potential major complications, including a fatal outcome as shown in table (2). The incidence and severity of complications depends on the setup where it is performed and more often when large volume liposuction is performed under general anaesthesia or combined with other major procedures like abdominoplasty. The incidence is highest when performed in a physician's office setting followed by ambulatory surgery centers and least in the hospital operating rooms.

Table (2): Complications following liposuction

Hypothermia
Thromboembolism
Pulmonary fat embolism syndrome
Pulmonary edema
Lignocaine toxicity
Hemorrhage
Abdominal viscus perforation Sepsis including necrotizing fasciitis
ARDS
Anaesthesia related complications

The incidence of mortality associated with liposuction is reported 0.003-0.02%. However, in a study by Hanke et al., no hospitalization and no blood transfusion was required in many cases of liposuction done under local anaesthesia using tumescent technique. The causes of death reported following liposuction have been cardiac arrest due to fluid overload, pulmonary edema, lignocaine toxicity, fat embolism, and acute respiratory distress syndrome (ARDS). It is believed that all patients undergoing liposuction surgery experience a thromboembolic shower due to fat particles being dislodged during surgery, resulting in pulmonary fat embolism syndrome. Pulmonary edema and over hydration have been attributed to absorption of the tumescent solution from subcutaneous to the intravascular compartment. This is most often seen with large-volume liposuction. Postmortem records of post liposuction deaths have evidence of weight gain of several kilograms, resulting in over hydration and death. Large doses of lignocaine may impair cardiac contraction and conduction, resulting in fatal arrhythmias. High levels of circulating lignocaine levels in the blood have been seen as postmortem evidence. Pulmonary embolism and abdominal viscous perforation were reported to be the two main causes of death. While addition of epinephrine to the wetting solution produces virtually a bloodless field, it may produce arrhythmias if the circulating levels are high. The incidence of wound infection and sepsis is very low after liposuction. There are few case reports of peritonitis following bowel perforation and necrotizing fasciitis after liposuction procedure.

1.8 Conclusion

Liposuction is a popular procedure for reducing excessive fat from the body. It is associated with major

hemodynamic changes, especially in large-volume liposuction surgery. Anaesthesia for these procedures requires a thorough understanding of the physiological changes and likely complications associated with them. Meticulous monitoring and strict adherence to guidelines for intraoperative fluid therapy ensures a good outcome.

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