Chapter 17
Patient Positioning and Positioning for Bariatric Surgery

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17.1 General Considerations for Patient Positioning

A coordinated approach among the surgical team and anesthesia providers allows for quick patient positioning and helps to reduce malposition. The ideal patient position is one in which the spine is in alignment and patient extremities are as close to neutral positioning as possible. Care must be taken to pad points of pressure with the goal of protecting peripheral nerves or skin from hard surfaces, poles, and other positioning devices.

IV sites and IV tubing (including invasive lines such as arterial or central access) should be checked to ensure they are free of tension and are not applying pressure to the skin and should be reassessed for flow to gravity once the patient is positioned. In addition to checking the IV(s), other monitors should be assessed for proper function, to make sure they are free from tension, and not run across the patient's body in a way that can lead to injury. For example, the pulse oximetry cable should be checked to ensure that the finger (or toe) it is attached to is in neutral position and that the pulse oximetry cable is run under patient limbs, ideally along the bedside to prevent nerve injury or ischemic injury to the extremities it runs along. EKG leads should be reassessed to ensure they are providing adequate signal. The individual EKG wires should be run under extremities they cross and checked to ensure they are not crossing over the neck. It is also important to make sure that the EKG leads are not placed in the surgical field (if possible). Lastly, the blood pressure cuff should be checked to ensure that it has not migrated and that the tubing does not cross over limbs in the same fashion as the IV tubing and other monitors. These checks are performed primarily by the anesthesia staff but other OR members are encouraged to speak up if they see anything amiss or at risk for causing injury to the patient.

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17.2 Considerations for Selected Positions and Changes in Physiology

17.2.1 Supine

Supine positioning is the most common position used for surgery and often is the starting position of choice for bariatric surgery. The patient is positioned on the table face up with the head, neck, and spine in alignment as seen in Fig. 17.1. The arms can be positioned in multiple variations with the recommended range of abduction <90° to prevent injury to the brachial plexus or ideally adducted next to the body. In addition, the hand and forearms can be placed in a range of rotation, with the palms facing inward in a neutral position (often the most preferred position due to minimal stretch of the ulnar nerve) or supinated so the palms are facing upward [2]. Supinated position of the hands and forearms still carries risk of stretch injury [3]. Careful attention should be paid to the bony prominences such as the elbow, sacrum, and heels, which should be adequately padded to prevent pressure injury from ischemia [4]. In addition to the above injuries, low back may be exacerbated in patients with this health issue. Monitors and IVs should be assessed for

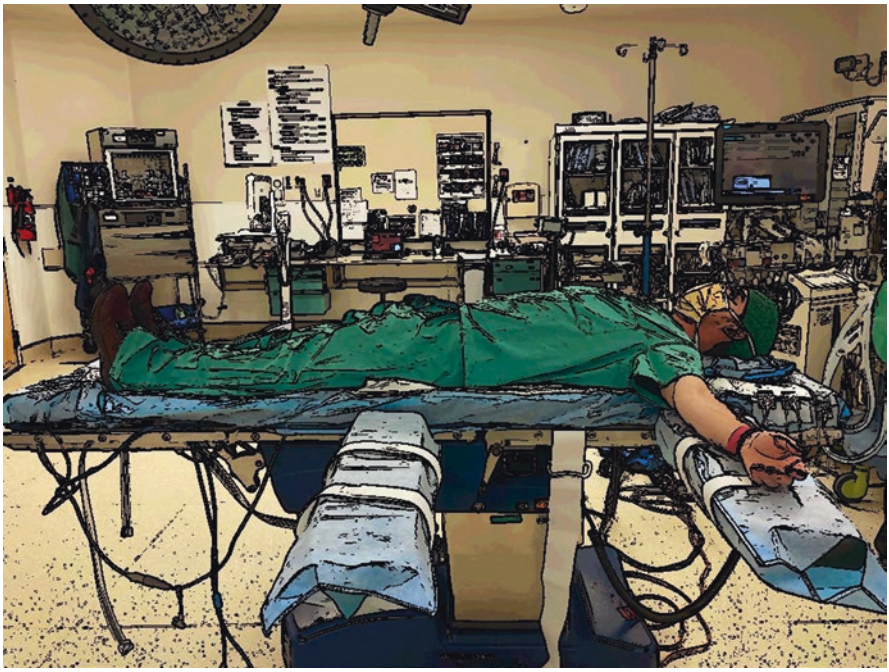

Fig. 17.1 Supine position. Note that the organs are at the level of the heart, the arms are abducted less than 90° at the shoulders, and forearm/hands are in a natural position, minimizing the stretch on the associated nerves. Photo credit: Austin McCarthy, original content

function, tension, and if possible should be run below the extremity to prevent injury. This position maintains most organs at the level of the heart which offers favorable hemodynamics.

There are multiple variations of the supine position that are frequently employed during bariatric surgery to promote surgical exposure and/or patient physiology.

Trendelenburg—in this position, the bed is tilted so that the head is lower compared to the feet as shown in Fig. 17.2. This helps to improve visualization of multiple structures in the abdomen including the gallbladder, appendix, and pelvic structures. Prior to initiating this position, it is important to ensure that proper devices are in use to prevent sliding: the patient is strapped to the bed, either via chest strap or waist strap; there is a bed gripper under the patient, or the use of shoulder braces. It is not recommended to use shoulder braces unless necessary due to increased risk of brachial plexus injury [5].

There are a myriad of physiologic changes associated with the Trendelenburg position. This position initially leads to an increase in venous return from the lower extremities that functions as an autotransfusion which leads to increased cardiac output; however this effect is temporary [6]. The weight of the abdominal organs and effect of gravity on the diaphragm cause a reduction in the lung volumes, increased work of breathing, and increased airway pressures which leads to more rapid desaturation, increased shunting, and during prolonged procedures can lead to

Fig. 17.2 Trendelenburg position. Note that the head is below the level of the heart and a safety strap is in place to prevent the patient from sliding. Photo credit: Austin McCarthy, original content

head and neck edema. Also of note is that for patients who have or are at risk for increased intracranial or intraocular pressure, this position should be used with extreme caution or not at all (most sources indicate this position is contraindicated when intracranial hypertension is present). When exiting this position, although the increased venous return is temporary, one should expect some degree of venous pooling in the lower extremities and thus a drop in blood pressure.

Reverse Trendelenburg—in this position, the patient is tilted so that the head is raised above the level of the heart as shown in Fig. 17.3. This position helps to improve visualization of upper abdominal structures due to the effect on gravity pulling abdominal structures toward the pelvis. Prior to initiating this position, it is important to ensure that proper devices are in place to prevent sliding: patient is secured with a safety strap; a bed gripper is beneath the patient; and use of a foot board is recommended if steep reverse Trendelenburg (greater than 30°) is to be used.

There are multiple physiologic changes that occur with the reverse Trendelenburg position. Since the head is above the level of the heart, the abdominal organs are shifted caudally, which helps to improve airway pressures and decrease the work of breathing. There is a loss of preload due to venous pooling in the lower extremities associated with this position so hypotension can be expected. Due to the reduction in preload, it is important to monitor blood pressures carefully, as cerebral perfusion

Fig. 17.3 Reverse Trendelenburg. Note that the head is above the level of the heart and the patient is held in place by a safety strap. Photo credit: Austin McCarthy, original content

relies on adequate blood pressure and the BP cuff is usually at the level of the heart and therefore pressure is higher at the cuff site. If invasive monitoring is used, it should be zeroed at the level of the Circle of Willis to adequately detect the blood pressure in the brain.

Lawn/beach chair position—in this position, the hips and knees are flexed using the leg portion of the bed, which helps to reduce strain on the low back as noted in Fig. 17.4. The upper body section of the bed can also be adjusted between 0 and 90° depending on the needs for the surgery. Although it does not provide optimal surgical positioning for bariatric surgery, in selected patients with low back pain or at risk of airway swelling it is used prior to induction and after surgery completion as the patient is waking up. This can also be considered a variation of the sitting position as described below.

17.2.2 Semi-fowler/fowler's

In this position, the upper body section of the surgical bed is raised anywhere between 5 and 90°, which causes the patient to flex at the hip. This is also referred to as the sitting position. Although this position is not used much for bariatric

Fig. 17.4 Lawn chair/beach chair position. Note the flexion of the hips and slight bend at the knees, which helps to reduce strain on the low back. Photo credit: Austin McCarthy, original content

surgery, it can be used to improve the bariatric/obese patient's respiratory mechanics and access to the airway both prior to inducing general anesthesia and when waking up from general anesthesia. Since the flexion of the torso occurs at the hip, patients are at risk of stretch injury to the sciatic nerve and if present, worsening of their back pain symptoms.

17.2.3 Lithotomy

In this position, the patient begins supine and as part of a coordinated effort the legs are raised simultaneously above the level of the head with the hips flexed and legs abducted from midline using various positioning devices. Commonly used devices include candy cane stirrups or support poles with well-padded boots to protect the patient's legs. Once the legs have been positioned, the foot end of the bed is lowered, allowing access to the perineum. This position is ideal for urologic, gynecologic, or peroneal/rectal surgeries.

In most textbooks, it is recommended the hips should be flexed between 80 and 100° and the legs abducted between 30 and 45° from midline. However, more recent case reports have identified multiple cases of sciatic nerve palsy when the hips are flexed past 90°, so aiming for hip flexion less than 90° is recommended to prevent this injury [3]. In addition to sciatic nerve palsy, special attention should be paid to the lateral femoral nerve, as abduction of the legs against the bed or positioning devices can lead to injury of this nerve, and thus minimizing the degree of abduction and appropriate use of padding is recommended [3]. The peroneal nerve is also at high risk for injury if attention is not paid to avoid pressure on the lateral fibular head. Although much attention has been paid to the lower extremities, the upper extremities are at risk of malposition as well. Since the bed is broken/lowered at the leg level, if the arms are tucked the fingers must be positioned correctly to prevent crush injury when the leg section is raised at the end of the surgery—it is recommended that the fingers be visible to prevent this injury. Additionally, if lithotomy and Trendelenburg are planned to be used, extra attention should be paid to the shoulders to ensure that there is no compression of the brachial plexus, especially if shoulder braces are used to prevent the patient from sliding.

This position carries with it physiologic changes similar to the Trendelenburg position. Lifting the legs above the level of the head temporarily increases venous return [6]. Flexion of the hips increases pressure on the intrabdominal organs and displaces them toward the diaphragm, which in turn reduces lung compliance. This leads to a decrease in lung volumes and increases airway pressures. In patients with increased abdominal mass (obese, gravid uterus, tumor), these effects can be very pronounced and can lead to cardiovascular collapse if one does not remain vigilant.

17.2.4 Lateral Decubitus

In this position, the position is rotated on their side, allowing better access to the thorax, hip, and retroperitoneal organs. The dependent, or down, side is padded and the knee of the dependent side flexed to reduce stretch of the associated nerves. Often, padding or pillows are placed between the knees to prevent ischemia from bony contact. The dependent arm is placed on a padded board while the non-dependent, or up, arm is positioned crossing the body with either pillows, a padded mayo stand, or some other device such as a padded stand attached to a pole. Keeping both arms abducted less than 90° at the shoulder is important to prevent injury to the brachial plexus. Addition of an axillary role on the dependent side is also important to prevent compression of the brachial plexus and axillary artery. Perfusion of the dependent arm can be assessed by measuring the blood pressure or placing a pulse oximetry monitor—low BP or poor O2 signal can indicate compression of the axillary artery and warrants further investigation to prevent injury.

17.2.5 Robotic Surgery

Since its introduction over 30 years ago, robotic surgery is becoming more popular as a method for minimally invasive surgery. Robotic surgery was initially used mostly for gynecologic and urologic surgery but has expanded in recent years to include abdominal, thoracic, and head and neck surgery. Many of the principles that apply to laparoscopic surgery also apply to robotic surgery with some additional considerations as detailed below.

The majority of bariatric surgery is performed in the supine position or some variation thereof. Since the majority of robotic surgeries have historically been urologic or gynecologic, the majority of data centers around Trendelenburg or Lithotomy position. However, as bariatric surgery is becoming more popular, other positions are seeing more use, namely, the reverse Trendelenburg position and for certain cases lateral decubitus (such as complex hiatal hernia surgery requiring approach through the abdomen and thorax). For bariatric surgery, steep reverse Trendelenburg (30–45°) often provides optimum exposure of the stomach, diaphragm, and other organs such as the duodenum and jejunum. Prior to positioning the surgical robot over the patient, it is important to reassess the position to ensure that the patient has not migrated, that all monitors and IV lines remain functioning well, and that no parts of the patient's body are in contact with positioning devices in a way that can cause harm.

Robotic surgery, as well as laparoscopic surgery, changes multiple physiologic parameters. Hemodynamic changes are caused by insufflation of the abdomen with CO_2, which leads to compression of the venous system, reducing preload and thus cardiac output. In addition to the changes experienced by the vascular system, the pulmonary system sees an increase in airway pressures and loss of tidal volumes due to collapse of the alveoli.

These physiologic changes associated with robotic and laparoscopic surgery can be further worsened depending on the patient position. In Trendelenburg position, airway pressures will be further increased and lung volumes further decreased. With the addition of CO_2 that is absorbed by the body during insufflation, blood CO_2 levels rise and it can be difficult to increase the minute ventilation to adequately ventilate the patient. The benefit of autotransfusion will be minimized secondary to insufflation pressures that decrease venous return. In reverse Trendelenburg, venous return is further reduced, often leading to hypotension. Although airway pressures are improved slightly compared to supine or Trendelenburg, they still are elevated compared to non-Robotic or open surgery. As such, mechanical ventilation can still prove to be challenging [7].

17.3 Summary

In summary, positioning is a team-based exercise that proper knowledge, vigilance, and execution can lead to improved patient outcomes, increased operating room efficiency, and decreased risk of injury. Although the positions described above are not all encompassing, these are the positions most frequently encountered in bariatric surgery. Additionally, it is important to recall the physiologic changes associated with the specific positions and the type of surgery that is being performed.

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