Review Article: Optimizing Operating Room Setup and Patient Positioning in Robotic Gynecologic Surgery

by Jana Publication & Research

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Abstract

Robotic-assisted gynecologic surgery demands meticulous attention to operating room (OR) setup and patient positioning to optimize surgical outcomes and minimize complications. This review synthesizes current best practices from a comprehensive chapter and a detailed presentation, supplemented by recent literature, focusing on key aspects for gynecologists. We discuss essential preoperative preparations, including patient selection, prophylactic measures, and uterine manipulator considerations. The optimal OR configuration, particularly the 'side docking' approach, and team positioning are detailed for efficient workflow. Critical elements of patient positioning, such as modified dorsal lithotomy and judicious Trendelenburg tilt, are examined. Furthermore, we highlight potential risks and complications associated with positioning, including neuropathies and ocular issues, and provide practical tips for mitigation. By adhering to these guidelines, gynecologic surgeons can enhance safety, efficiency, and overall success in robotic procedures.

Introduction

Robotic-assisted surgery has revolutionized various surgical disciplines, including gynecology, offering enhanced precision, dexterity, and visualization compared to traditional laparoscopic approaches. The increasing adoption of robotic platforms necessitates a thorough understanding of optimal operating room (OR) setup and patient positioning to ensure patient safety, surgical efficiency, and favorable outcomes. This review article aims to synthesize current knowledge and best practices regarding OR setup and patient positioning specifically for robotic gynecologic surgery, drawing insights from a comprehensive chapter and a detailed presentation on the subject, supplemented by recent literature.

Preoperative Preparation

Effective preoperative preparation is paramount for successful robotic gynecologic surgery, encompassing patient selection, comprehensive evaluation, and specific prophylactic measures. Patient selection should carefully consider indications for robotic surgery alongside existing comorbidities. Patients with conditions such as obesity, pulmonary, cerebral, vascular, cardiac, or ophthalmologic disorders (e.g., glaucoma) require particular attention and, ideally, evaluation by relevant specialists prior to surgery [Chapter, p. 2]. A thorough discussion with the patient is essential, covering the advantages and disadvantages of robotic surgery, as well as alternative treatment modalities. Obtaining informed consent is a critical step in this process [Chapter, p. 2].

Standard preoperative investigations include a complete blood count, blood typing and crossmatch, coagulation studies, a metabolic panel, chest X-ray, and electrocardiogram [Chapter, p. 2]. While routine mechanical bowel preparation or nasogastric tube placement is generally not recommended, a nasogastric tube can be beneficial in cases of large uteri where the primary port is planned near Lee Huang's point, as it decompresses the stomach and reduces the risk of injury during port placement [Chapter, p. 2]. Mechanical bowel preparation is reserved for specific scenarios, such as advanced endometriosis where extensive bowel adhesions are anticipated [Chapter, p. 2].

Infection prophylaxis typically involves administering intravenous cefazolin 1 gram, 5 to 10 minutes before the induction of anesthesia [Chapter, p. 2]. Deep vein thrombosis (DVT) prophylaxis is strongly recommended for all patients undergoing robotic gynecologic surgery, irrespective of individual risk factors, aligning with current best practices. This can include intermittent pneumatic compression and chemoprophylaxis with low-molecular-weight heparin [Chapter, p. 2].

A crucial component of preoperative preparation unique to gynecologic surgery is the selection and placement of a uterine manipulator. Devices such as the RUMI Arch with KOH colpotomizer, Clermont-Ferrand, or Mangeshkar manipulator facilitate uterine movement within the pelvis, aiding in dissection, coagulation, delineating vaginal fornices, and minimizing the risk of ureteral injuries [Chapter, p. 2]. The choice of manipulator often depends on surgeon comfort and familiarity [Chapter, p. 2].

Operating Room Setup

Unlike open or traditional laparoscopic surgery, robotic surgery is highly equipment-intensive, requiring meticulous planning and arrangement of the operating room (OR) to ensure efficient workflow and patient safety. The da Vinci robotic system, a widely used platform, comprises three primary components: the patient cart, the vision tower, and the surgeon's console [Chapter, p. 9; Presentation, slide 5]. Adequate space within the OR is crucial to allow for unhindered maneuvering of this equipment [Chapter, p. 9].

A common and effective OR setup in gynecologic robotic surgery is the 'side docking' approach. In this configuration, the patient cart is typically positioned on the right side of the patient. This strategic placement ensures that the space between the patient's legs remains free, allowing for optimal uterine manipulation by the assistant [Chapter, p. 9; Presentation, slide 9]. The vision cart is generally situated on the patient's left side, providing the surgical team with a clear view of the operative field [Chapter, p. 9; Presentation, slide 9]. The surgeon's console, where the primary surgeon controls the robotic instruments, is located several feet away from the operating table, often in a corner of the OR to maintain a sterile field and provide an ergonomic workspace [Chapter, p. 9; Presentation, slide 9].

Team positioning within the OR is equally vital for seamless robotic procedures. The first assistant typically stands at the patient's left side, while the second assistant is positioned at the patient's right side. A third assistant may be situated between the stirrups, particularly for tasks related to uterine manipulation or instrument exchange [Chapter, p. 9; Presentation, slide 9]. Each member of the surgical team is assigned a specific role, and clear, constant communication between the bedside assistants and the console surgeon is paramount for the safe and efficient progression of the robotic surgery [Chapter, p. 9]. Safe instrument exchange at the bedside, with minimal assistance from the first assistant, is a key aspect of this coordinated effort [Chapter, p. 9].

Patient Positioning

Optimal patient positioning is a critical determinant of success in robotic gynecologic surgery, ensuring adequate exposure of pelvic structures while preventing patient injury and complications [Chapter, p. 9; Presentation, slide 12]. Given that robotic gynecologic procedures primarily focus on the pelvis, the Trendelenburg position in the dorsal lithotomy position is essential [Chapter, p. 9; Presentation, slide 14].

The modified dorsal lithotomy position is recommended, utilizing adjustable leg support devices such as Allen stirrups, which provide excellent leg positioning and protect pressure points [Chapter, p. 10; Presentation, slide 19]. Key parameters for this position include maintaining minimal external hip rotation, with hip flexion (thigh-trunk angle) between 100 and 170 degrees (never exceeding 180 degrees), and knee flexion typically between 90 and 120 degrees. Hip abduction should be less than 90 degrees [Chapter, p.

10; Presentation, slide 15]. It is crucial that the thighs remain at or above the plane of the table, and the patient's knees should not be higher than the abdomen to prevent collisions with the robotic arms [Chapter, p. 10; Presentation, slide 15]. The buttocks should be positioned 2 to 3 cm beyond the edge of the table to facilitate easy manipulation of uterine elevators [Chapter, p. 10; Presentation, slide 19].

Historically, steeper Trendelenburg positions (30-40 degrees head low) were often employed to utilize gravity for organ displacement and create space for robotic instruments [Presentation, slide 14]. However, with increasing experience, a less extreme tilt of 20 to 25 degrees is now commonly used for gynecologic robotic surgeries, providing sufficient surgical exposure without the heightened risks associated with steeper angles [Chapter, p. 11; Presentation, slide 20]. Prior to docking the robotic cart, the robotic telescope can be used to visualize the entire abdomen, allowing for displacement and tucking of the small bowel and sigmoid colon cephalad, further optimizing the operative field [Chapter, p. 11; Presentation, slide 20].

Proper arm and hand positioning is also vital. Arms should be tucked to the sides of the table, not at an angle to the torso, to prevent brachial plexus injuries. Pads placed below the elbows can prevent ulnar nerve injury. Hands should be in a neutral position, with thumbs pointing upwards and unclenched palms facing the thighs. Intravenous lines must be maintained to avoid obstruction when tucking the arms [Chapter, p. 11; Presentation, slide 17]. The head should be stabilized in the midline position using pads or foam, and foam or cloth pads should cover the face to prevent injury from camera arm movements. Artificial tear drops and taped eyelids are recommended to prevent corneal abrasions or injury [Chapter, p. 11; Presentation, slide 18].

Risks and Complications Associated with Positioning

While essential for surgical access, the Trendelenburg and dorsal lithotomy positions used in robotic gynecologic surgery carry inherent risks and potential complications. Prolonged Trendelenburg positioning can lead to a range of adverse effects, including increased risk of hemodynamic complications, ventilatory difficulties, decreased pulmonary compliance, and edema in the face, head, and neck [Chapter, p. 10; Presentation, slide 16]. Of particular concern are ocular complications such as increased intraocular pressure, ischemic optic neuropathy, and even blindness, as well as corneal abrasions or ulceration [Chapter, p. 11; Presentation, slide 16].

Neuropathies are another significant risk associated with patient positioning. The lithotomy position can increase the risk of nerve injury in the lower limbs, affecting nerves such as the femoral, obturator, sciatic, lateral femoral cutaneous, and common peroneal nerves, potentially leading to motor or sensory deficits postoperatively

[Chapter, p. 10; Presentation, slide 16]. Brachial plexus injury, though less common, has also been reported in laparoscopic and robotic gynecologic surgery [Chapter, p. 10; Presentation, slide 16]. Abnormal arm positions, especially if not properly tucked, can contribute to brachial plexus stretching [Chapter, p. 11].

Inadvertent cephalad skidding of the patient during steep Trendelenburg positioning is a unique challenge in robotic surgery. The rigid nature of robotic arms, once docked, cannot accommodate this shift, potentially causing a pull at the port site and injuring the abdominal wall [Chapter, p. 10; Presentation, slide 16]. Furthermore, the robotic arms themselves can mechanically injure the patient's legs if not carefully positioned and monitored throughout the procedure [Chapter, p. 10].

Practical Tips for Optimization

To mitigate the risks associated with patient positioning and optimize outcomes in robotic gynecologic surgery, several practical tips are recommended:

- **Avoid Steep Trendelenburg:** Instead of steep Trendelenburg positions, aim for a more moderate tilt of 16-25 degrees. This provides adequate surgical exposure while significantly reducing the risk of hemodynamic, ventilatory, and ocular complications [Chapter, p. 11; Presentation, slide 20].
- **No Shoulder Braces:** Shoulder braces should be avoided as they can contribute to brachial plexus injury. Instead, utilize an anti-skid mattress under the patient to prevent caudal slipping during Trendelenburg positioning [Chapter, p. 11; Presentation, slide 20].
- **Pre-docking Bowel Displacement:** Before docking the robotic cart, use the robotic telescope to visualize the entire abdomen. Displace and tuck the small bowel and sigmoid colon cephalad to clear the operative field and improve visualization [Chapter, p. 11; Presentation, slide 20].
- **Optimal Arm and Hand Positioning:** Ensure arms are tucked securely to the sides of the table, with palms facing the thighs and thumbs pointing upwards. This prevents brachial plexus injury. Place pads below the elbows to protect the ulnar nerve [Chapter, p. 11; Presentation, slide 17].
- **Head Stabilization and Eye Protection:** Stabilize the head in the midline position using a foam or bean bag. Cover the face with foam or cloth to prevent inadvertent injury from camera or robotic arm movements. Apply artificial tear drops and close the eyes with tape to prevent corneal abrasions or ulceration [Chapter, p. 11; Presentation, slide 18].
- **Leg Protection and Stirrup Use:** Use gel pads on the posterior and lateral parts of the legs to prevent nerve injury. Allow the legs to rest on the heel by using

appropriate stirrups, preferably pneumatic Allen/Yellofin stirrups, which are boot-shaped and protect pressure points [Chapter, p. 10; Presentation, slide 19].

- **Modified Dorsal Lithotomy Parameters:** Adhere to the modified dorsal lithotomy parameters: minimal external hip rotation, hip flexion (thigh-trunk angle) between 100-170 degrees (never beyond 180 degrees), knee flexion between 90-120 degrees, and hip abduction less than 90 degrees. Ensure thighs remain at or above the table plane and knees are not higher than the abdomen to avoid robotic arm collisions [Chapter, p. 10; Presentation, slide 15].
- **Communication and Teamwork:** Maintain clear and constant communication between the bedside assistants and the console surgeon. Each team member should be aware of their role and responsibilities to ensure safe instrument exchange and overall surgical progress [Chapter, p. 9; Presentation, slide 9].

Conclusion

Optimizing operating room setup and patient positioning is fundamental to the success and safety of robotic gynecologic surgery. A well-prepared patient, a meticulously arranged operating room, and precise patient positioning are interdependent factors that contribute significantly to surgical efficiency, reduced complications, and improved patient outcomes. Adherence to established guidelines for preoperative assessment, thoughtful OR configuration, and careful patient positioning—including appropriate limb and head placement, and judicious use of Trendelenburg—are crucial. Continuous education and training for the entire surgical team are essential to master these techniques and adapt to evolving robotic technologies. By prioritizing these critical elements, gynecologic surgeons can maximize the benefits of robotic surgery while minimizing associated risks, ultimately enhancing patient care.

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