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Setup and positioning in robotic colorectal surgery

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A B S T R A C T

Preparation for robotic colorectal surgery is more complicated than open and laparoscopy approaches. The colorectal surgeon interested in robotic training should be familiar with and well prepared for robotic draping, positioning of the operating table, the patient cart, the vision cart, the surgeon console, and other operating equipment. Port placement requires more strategy than for the laparoscopic platform and differs depending on the type of robotic system utilized. Anesthesia personnel should be prepared for potential airway issues related to operating table and patient positioning. Robotic technology is complex and, though the system checks itself at an enormously rapid rate, there is a low incidence of robotic malfunction. All operating room personnel should be familiar with these malfunctions and how to resolve them.

Introduction

Studies to date have demonstrated several advantages for the robotic platform in the field of colorectal surgery.[1–3] There are several key differences in setup and positioning when compared to open and laparoscopic surgery. Equipment setup, port placement, and docking depend upon the planned anatomic resection. Anesthetic protocols may be affected by these nuances and anesthesia personnel should be involved in the planning process. In addition, it is important that the surgeon and operating room staff have a clear understanding of how to identify and ameliorate malfunctions with regard to the instruments, the robot arms, and the robotic computer system. A dedicated robotics nursing staff well trained and well prepared in equipment setup, patient positioning, docking, and robot malfunction leads to decreased operative times and better operative experiences.

General robot setup

Prior to any operation, the general setup of the operating room needs to be conducive to performing a robotic operation. Consideration should be given to the position of each component in the room, keeping in mind the ability to reposition the operating room table as needed. The main components include the patient cart, the vision cart, the surgeon console, and all other operating room equipment.

The patient cart should be draped in a sterile fashion in a way that allows it to be maneuvered toward the patient without contamination, so that it can be united with the sterile field over the patient. The surgeon console should be positioned outside the sterile field in such a manner that the surgeon can visualize the operating table at all times and provide effective communication with the bedside assistant. The vision cart should be positioned outside of the sterile field, but visible to the bedside assistant. It is possible to drape the monitor in a sterile fashion to bring it closer to the sterile field. Cable connections, draping, camera assembly, and use of the touchscreen monitor should be familiar to all operating room personnel.

Docking and general port placement

Effective docking requires practice and preparation and depends on the operation to be performed. For the Si® system, many dock the robot over the left hip for sigmoid and low-anterior resections, and over the right side for right colectomies. The Xi® platform allows more docking options and total colectomies are possible without re-docking the robot. It is best to store the robot in a dedicated spot in the operating suite and position the operating table in a fashion that allows the robot to be simply moved straight forward to the operating table over the shortest possible distance. This habit decreases the risk of costly robotic cable damage that can occur with excessive transport. Anesthesia personnel should be familiar with these coordinated maneuvers so that positioning does not interfere with airway management.

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While there are no strict rules governing port placement, there are some basic guiding principles. These guidelines ensure an optimal camera view, minimal external collisions, and maximal reach of the operating instruments. All ports should be positioned in relation to identification of the target anatomy. After gas insufflation, the camera port is placed first and should be in line with and 10–20 cm away from the target anatomy. Instrument cannulas are then placed under direct laparoscopic or robotic camera vision. These additional ports should be triangulated toward or away from the target anatomy. Each instrument port should also be 10–20 cm from the target anatomy. Placing ports greater than 20 cm from the target anatomy may place the dissection field out of reach of the robotic instruments. Robotic cannulas should not be placed between the camera port and the target anatomy as this may result in internal instrument and external robotic arm collisions. Assistant ports (noninstrument cannulas) should be placed as needed. When docking, the camera port, target anatomy, and patient cart should be in a straight line to maximize range of motion of the robotic arms, though side docking is also a widely used option.

General anesthesia concerns

All patients should be thoroughly evaluated with attention to identifying comorbidities with appropriate interventions prior to the administration of general anesthesia. Consideration should be given in preparing for the possibility of conversion to open from the minimally invasive approach. Additionally, patients should have enough cardiopulmonary reserve to tolerate carbon dioxide pneumoperitoneum of 15 mmHg. The laparoscopic risks of air embolism, bradycardia with gas insufflation, subcutaneous emphysema, hypercarbia, and potential cardiovascular collapse are also potential complications to be aware of during robotic colorectal surgery[4] (Fig. 1).

During pelvic operations, the patient is often placed in steep Trendelenburg tilt while in lithotomy position, with both arms tucked at the sides. These patients are at risk to slide off the table, so efforts to minimize this problem are crucial. Padding specifically designed to prevent slippage is available for these procedures. In addition, extra safety straps, bean bags, and taping of the patient to the table around the chest should be utilized strategically. Care should be taken to ensure that the patient is able to ventilate if the chest is taped. Extremities should be padded to prevent neurovascular injuries.

The steep Trendelenburg position decreases the length of the trachea by approximately 1 cm and, in conjunction with a retroperitoneal dissection, increases the absorption of carbon dioxide.[5] Increased pressure on the thoracic cavity by intraabdominal organs in this position reduces lung compliance and functional residual capacity.[6] Strategies employed to ameliorate these deleterious effects include maintaining tidal volumes of 6–8 ml/kg, positive end expiratory pressure (PEEP) of 4–7 cm H_2O, and maximum airway pressures of less than 35 cm H_2O.[7] Epidural analgesia, pressure control ventilation, and prolonging the inspiratory:expiratory ratio may decrease maximum airway pressure and improve oxygenation and ventilation.[8,9]

Central venous pressure, pulmonary artery pressure, and pulmonary capillary wedge pressure increase with increasing degrees of Trendelenburg tilt.[10] In addition, cardiac output and cardiac index are decreased due to decreased venous return and increased systemic vascular resistance, which may result in increased myocardial oxygen demand.[11,12] Increases in intraocular pressure resulting in blindness and increased intracranial pressure have been reported with steep Trendelenburg positioning during minimally invasive surgery.[13–16] The robotic colorectal surgeon should be aware of these potential complications.

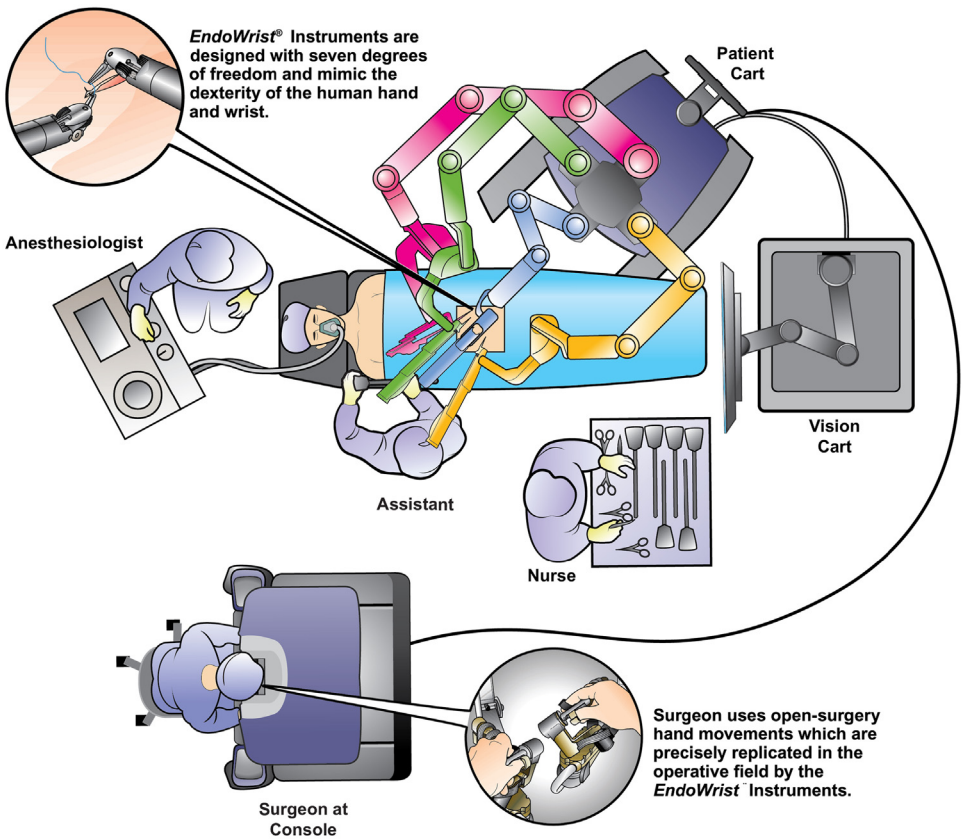

Fig. 1. Setup and docking for sigmoid resection/low-anterior resection/abdominoperineal resection.