The words of Hippocrates, “Do no harm,” are recited universally by practitioners of medicine. The contemporary trends of minimally invasive surgery and robot-assisted surgery are an endeavor to reduce the harm of an operation. Robotic surgery has been bolstered by the dramatic increase in number of robotic units, robotic surgeons, and robotically performed operations worldwide. As part of developing and maturing a robotic surgical program, the training of bedside assistants is an important yet often overlooked initiative.

The bedside assistant is a fundamental member of the robotic team and assumes numerous roles during surgery. By virtue of physical proximity, the assistant acts as the robotic console surgeon’s link to the patient. Depending on the type of surgical practice, assistants can be residents, fellows, physician assistants, nurse practitioners, or registered nurse first assistants. While institutions may vary on the type and number of bedside assistants, as well as their previous laparoscopic experience, the core concepts remain the same (Mandhani, Tewari, & Berryhill, 2007). A reproducibly efficient robotic team and operation requires readiness and repetition, adherence to a standard set of operative principles, and the ability to adapt quickly when necessary. Meticulous attention to detail and considerable study are required to become proficient as a robotic bedside assistant.

More than 6,000 robotic surgeries have been performed at the author’s institution in a number of disciplines, mainly urologic procedures. Over time, the institution’s views on the bedside assistant have evolved. The literature examining the roles and responsibilities of the bedside assistant is sparse. This article presents a technical primer on the robotic operation from the bedside perspective and suggests methods of achieving proficiency.

Preparation

The first phases of becoming a skilled bedside assistant are understanding the anatomical relations and memorizing the steps of the operation. A clear appreciation of the pertinent anatomy, surrounding structures, orientations, landmarks, and anatomical variations is imperative to work synergistically with the console surgeon and avoid inadvertent iatrogenic injury to the patient. This familiarity with the surgical procedure can be attained in a relatively short time but requires exposure to several cases. The initial understanding and comprehension that follows become a library of reference for each successive case.

Internalization of the procedural steps in robotic surgery can be most rapidly assimilated by acting as the assistant. However, the steps are initially most safely learned by close observation, which can be achieved by watching live operations or by studying recorded video of cases. The dynamic means of learning through an interactive live case is preferred and invaluable. A bedside assistant mentor can demonstrate how outside motions affect instrument movement onscreen, an interplay that recorded video cannot capture. All procedural steps should be memorized, and the assistant should try to think and plan several steps ahead. In many operating rooms, it is standard process to record objective operative parameters, such as robot docking time and console time. Similarly, after every operation, the assistant should main-
tain a log outlining things that worked well, challenges, and what could be modified for continuous improvement. Due to variable port locations, proficiency with both hands laparoscopically is valuable. These skills are derived from case experience and dry laboratory practice, or transferred from prior laparoscopic exposure. Memorization of steps for each specific console surgeon is a more advanced skill and requires development of a rapport with each surgeon (Degon, 2010).

**Set Up**

Once the patient is positioned, insufflation of the working space and pneumoperitoneum are achieved, and port sites are chosen. Adequate spacing of ports allows for ease of movement for dissection and prevention of instrument clashing. Clashing occurs when the robotic arms disrupt the motion of other robotic arms, the camera, or the assistant’s instruments. The instruments may interfere inside the body as well as outside. To prevent this from occurring, the expected trajectory of the robotic instruments in relation to the axis of the body and each other must be considered at the time of port site selection. Generally, a handbreadth distance between ports is enough space to reduce clashing, although this may vary depending on body habitus or prior incisions (Tewari et al., 2002).

The console surgeon selects the port sites, but the mobility of the bedside assistant’s instruments must be considered in that selection. A movement-limited suction/irrigator can slow case progression by preventing adequate visualization and increase the technical difficulty from both the console and the bedside. Ports should always be placed under direct vision to prevent trocar injury (Crist & Gadacz, 1993). Maintenance of pneumoperitoneum may require frequent port checks to ascertain for the absence of leaks in the system. From his or her side of the table, the assistant can help insert the ports and dock the robotic arms. The robotic portion of the case may then commence.

**Application**

**Passage of Laparoscopic Instruments**

Unfortunately, the assistant’s instruments may be the cause of injuries to viscera or vessels due to off-screen motion. At the commencement of the case when the console surgeon is preparing to engage the console, the laparoscopic instruments can be passed into the body under direct vision. Uninhibited passage should be confirmed, and the angle of passage should be noted. At this time, creating a 3D spatial map by considering patient position, anatomical landmarks, and the path to the point of surgery is helpful. This mental map can then be used to guide insertion of each instrument. Subsequent entries should be performed the same way each time to prevent wasted motion and accidental injury to structures. Muscle memory becomes heightened with experience. A general familiarity develops with time, yet an understanding of nuances relative to anatomic variability is necessary since dimensions and port sites on each patient will differ slightly.

The initial survey with instrument path memorization is important because the assistant instruments are commonly removed and reinserted. Entry of instruments on the periphery of the screen can provide a distraction for the console surgeon and even obstruct the field of vision. With practice, the assistant instruments can be kept just off the screen but ready at a moment’s notice. In most scenarios, motion control should be direct and smooth without erratic movement. This reduces the risk of injury to the patient if the instruments are to contact vital structures.

**Exchange of Robotic Instruments**

The assistant will frequently be in charge of swapping out the various robotic instruments. The current version of the da Vinci robot stores the instrument position upon removal and easily guides replacement of said instrument. However, the risk of major injury through negligent robotic instrument exchange still exists. Again, the path must be memorized, and if any resistance is met, the action should not be forced. Ports may pull back into the fascia, which may require undocking and repassage of the trocar. Additionally, instrument replacement into the same position does not guarantee safety if the conditions have changed intracorporally (for example, the intestines move into the path of entry).

**Suction**

The suction/irrigator is a multidimensional tool that can also be used as a retractor and dissector, and for tamponade. Initially, the assistant may have difficulty keeping the surgical field dry and spend inordinate time inefficiently suctioning. This is true especially early on in a surgical assistant’s career if he or she is starting out with a new console surgeon whose hemostatic technique may not be as refined. Blood in the operative field makes structures harder to see, obscures landmarks, and darkens the field due to absorbance of light. When inactive, the suction should be kept out of the way, yet be nearby.

Once laparoscopic proficiency of the assistant improves, there can be a tendency to overuse the suction in an effort to keep the field pristine. This may be counterproductive if the pneumoperitoneum is sacrificed and paradoxically leads to more bleeding and even more suctioning. A fine balance exists between over and under-suctioning. The goal should be to suction just enough to keep the immediate field clear. Suctioning in a pool is more efficient in
terms of fluid to air evacuation ratio. Judicious periodic evacuation of smoke can keep the vision clear without compromising the pneumoperitoneum.

Irrigator
When the operative field is too stained to visualize well or when significant clots are present, the irrigator can be used. The spray from the irrigator must be carefully controlled to prevent soiling of the camera lens. It can be helpful to have the console surgeon move the camera a short distance away, but this is not always necessary or possible. With slight controlled pressure on the irrigator, the splash can be restricted. Further irrigation once the tip is introduced into the fluid pool may be simpler with less chance of camera soiling.

Suction: Additional Uses
When working in a confined space, the suction may serve as a retractor to push tissues, nerves (for example, obturator), or vessels away from the point of dissection as a safety measure or visualization tool. Tension of retraction can be easily visualized on the monitor and correlated with the feedback of the amount of tension felt on the handle of the instrument. This retraction can be actively repositioned to provide optimal retraction, dynamically acting in such a way that the fourth robotic arm cannot.

Assistants with previous laparoscopic training may find the suction to be more than adequate as a blunt dissector. Few scenarios require the assist to perform considerable dissection, but if the robotic arms are unavailable, the suction may suffice. With smooth but deliberate movements, tissue planes can be separated without major injury to visceras or vessels.

In cases of small vessel bleeding, the suction may manually compress as a finger would in an open case. Direct pressure with the suction or through a gauze pad or hemostatic matrix may allow enough time for the console surgeon to control bleeding or even stop the bleeding altogether.

Assistance with Dissection
The time-tested surgical device of traction and countertraction is just as applicable in robot-assisted surgery. While the suction provides a leaning retractive force, a grasper-type instrument is able to provide retraction in a pulling fashion, allowing for traction at different angles and forces. A toothed grasper is able to securely latch onto tissues providing retraction to one side or the other, which frees up the fourth robotic arm to retract elsewhere. As surgical conditions change in real time, traction planes will shift, and the grasper needs to be adjusted.

Removal of Specimens
Specimens of caliber less than the diameter of the assistant port may be grasped and then removed through the port. Occasionally, it may be easier to remove the specimen along with the cap of the assistant port to prevent specimen loss in the port. Care must be taken not to lose the pneumoperitoneum with this maneuver. Larger specimens may require entrapment by bagging. Opening the bag once positioned inside an empty space allows for full bag expansion. For example, the deep pelvis after the prostate has been excised or the renal fossa after the kidney has been excised are ideal for bag opening. Once the specimen is placed into the bag, the bag may be gently lifted up toward the abdominal wall for the specimen to settle into the dependent portion of the bag or allow the bag to unfurl. The console surgeon may also provide assistance.

Clip Application
Plastic clips are commonly used for hemostasis or more recently described as a means of performing renorrhaphy (Benway, Wang, Cabello, & Bhayani, 2009). Metallic clips are also used but may interfere with future magnetic resonance imaging (MRI). The clip applier may initially be controlled with two hands to provide support and more accurate articulation for placement, as with a stapler. With more experience, clip articulation and firing can be easily performed with one hand. Whenever clips are placed, it is important to make sure that the tips of the clip are not entrapping other possibly vital tissue. The hooked end of an interlocking (Weck) clip can be snagged on structures and can occasionally cause injury.

Needle Control
If robotic intracorporeal suturing is anticipated, needles will need to be passed into the working cavity. Accurate and efficient entry and removal of needles is a patient safety measure and prevents operative delay. Time wasted recovering a lost needle or with delayed hemostatic control is preventable. The suture is grasped by the thread and passed through the port. Upon completion of knot tying, the suture should be cut and the grasper used to again grab the suture a few centimeters from the needle.

Stapler Application
There are a number of different surgical stapling devices available on the market, and it is important to learn the firing mechanics of the stapler prior to use. Before firing, check the ends of the stapler and make sure the desired tissue for cutting is between the staple lines of the stapler being used.

Sharp Dissection
Intrabdominal adhesions can prevent initial robotic port placement. Thus laparoscopic lysis of adhesions may at first be required. Traction with a grasper away from the abdominal wall places the adhesion planes under tension and defines where to incise. With the robot docked,
scissors or a sharp-pointed dissector can easily cause puncture injury to adjacent structures. The assistant must be aware of the surroundings at all times and never force the instrument. If upon entry of the instrument resistance is felt, the instrument may be running into an organ or the port may have backed into the subcutaneous tissue. Scissors may be used when the robot is docked for cutting suture and tissue. It may be prudent to confirm point of cutting with the console surgeon, especially around critical structures because depth perception of the three-dimensional console is superior to two-dimensional monitors (Wagner et al., 2012).

When Complications Arise

Over time, unforeseen complications will occur. This is when preparation, training, and experience pay off. If anesthesia complications arise, the assistant must be prepared to release the pneumoperitoneum, undock the robot, potentially reposition the patient, and provide resuscitation. When intraoperative complications occur, the bedside assistant is first at the scene. In uncontrolled bleeding damage situations, the first step is a brief trial to tamponade. If this is unsuccessful, and other measures must be taken (increasing pneumoperitoneum, insertion of gauze pads, hemostatic agents), conversion to open surgery may be necessary. The instruments must be safely removed and the robot undocked. A quick plan of surgical control and appropriate incisions are made. Nursing staff must always be informed of the possibility of an open surgery, and the instruments should be prepared. In other cases, a failure to progress may occur for a number of reasons. The assistant should always be prepared to complete each case whether robotically or open.

Conclusion

A skilled bedside assistant is an essential part of an effective robotic surgery team. Roles and responsibilities for assistants will change in the future, but they remain a vital bridge between the console surgeon and the patient. Preparation can pay dividends in terms of understanding the operation, improving the overall flow and management of unanticipated circumstances. The ability to work in concert depends on effective communication and repetitive execution.

References


