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Original Research Article

Scope and challenges of robotic surgery: a trainee's perspective

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ABSTRACT

Background: Robotic surgical technology is here to stay and training on the platform is a necessity for all surgeons. It is an advancement over laparoscopy as a minimally invasive technique. It overcomes many challenges associated with laparoscopy while simplifying the learning process of minimally invasive surgery.
Methods: It is a prospective observational study of patients who presented to the administrative unit within the Department of Surgical Oncology, MNJ institute of oncology and regional cancer center and planned for robotic surgical procedure
Results: A total of 59 cases have been performed in a single administrative unit of Department of Surgical Oncology, MNJ institute of oncology and Regional Cancer Center from September 2023 to January 2025 over a period of 17 months of which 61 % (n=36) were females and 39% (n=23) were males. The age range of operated patients was 23-72 years. 51-60 years was the most common age group 28.8% (n=17). Colorectal surgeries and gynecological surgeries share 42.3% each (n=25). The most common surgery performed was robotic radical hysterectomy 40.6% (n=24) which mimics patient load patterns of the department.
Conclusions: Learning skill sets over the robotic platform is facilitated by the prior learnings in executing laparoscopic surgery. The authors do not agree to popular misconception that one needs to unlearn certain skills from laparoscopic surgery to transform into robotic surgeons and infact, they believe prior laparoscopic experience is a favorable qualification.

Keywords: Da vinci, Oncology, Robotic surgery, Trainee

INTRODUCTION

Surgery as a modality of treatment is the most effective and successful technique in the management of curable solid cancers.[1] Most cancer surgical procedures involve identification of fine tissue planes and avoid breaching the planes to achieve 3 dimensional margins. The cancer surgeon needs to ensure protection of vital structures like nerves and vessels as deemed necessary. All these requirements of cancer surgery demand a deep understanding of the anatomy along with dexterity, nimbleness of the fingers and occasionally strength to retract without crushing tissues. Traditional open surgical methods involve large incisions to ensure appropriate exposure of the target area and facilitate proper lighting, vision and movement of surgeons' hands.[2,3] Limited visibility deep in the pelvis and around the diaphragm might not allow the surgeon to do what is optimum in spite of large incisions. Many of these challenges have been overcome by the laparoscopy which has allowed a magnified view, close vision of the target along with small incisions reducing post op morbidity.[4] But learning the laparoscopic techniques is difficult and prolonged.[5] Further the counter intuitive movements, the lack of articulation at the tips of the instruments added difficulty in executing certain complex steps. Disengagement of visual and motor axis adds difficulty in learning the skills but also physically challenging to the surgeon.[6] Robotic platforms dramatically overcome all these challenges of

both the traditional open and laparoscopic surgeries.[7,8] It has been successfully used across all surgical specialties and has made great inroads into cancer surgery.[9] The present study is to compare our experience with robotic cancer surgeries to our prior experience with open and laparoscopic surgeries at our institute.

Aims and objectives

Articulating the learning strategies, opportunities and challenges in robotic surgery in comparison with open and laparoscopic surgery. Exploration of scope of robotic surgical platform in cancer surgery. Auditing our experience in executing robotic surgeries in a predominantly open surgical environment.

METHODS

It is a prospective observational study of patients who presented to the administrative unit within the Department of Surgical Oncology at MNJ institute of oncology and regional cancer center, Osmania medical college, Hyderabad, Telangana from September 2023 to January 2025 over a period of 17 months. The da vinci xi robotic system was used.

Data collected included demographics, diagnosis, procedure planned, any relevant intraoperative information, Pathological information like margins, nodal status and post-operative information about possible leaks, infection and discharge data.

Information was collected in excel sheets and the study has institutional ethics committee permissions. No financial or ethical conflicts noted. Statistical analysis was done in Microsoft excel.

Inclusion criteria

All patients who were drafted for Robotic surgery were included across all cancer surgeries routine for the institution. The decision for robotic methodology was decided case by case considering the patients choice, surgeons' thoughts and anesthesiologist insights.

Exclusion criteria

Patients whose data were incomplete and who were operated by surgeons other than the authors were excluded in the study.

RESULTS

A total of 59 cases have been performed in a single administrative unit of Department of surgical oncology, from September 2023 to June 2025 of which 61 % (n=36) were females and 39% (n=23) were males (Figure 1). The age range of operated patients was 23- 72 years. 51-60 years was the most common age group 28.8% (n=17) (Table 1). Colorectal surgeries and gynecological surgeries share 42.3% each (n=25) (Figure 2 and 3). Out of 59, 50 (84.75%) cases were operated by robotic surgery, 8 (13.56%s) cases were converted to open, 1 case ca cervix was inoperable due to bladder infiltration (Figure 4). Out of 8, 3 cases were converted due to vascular injury, 4 cases due to inability to progress and 1 due to adhesions.

Anatomical learning

Prior exposure to laparoscopy will familiarize the operative anatomy in robotic surgery. The biggest challenge in the mastery of minimally invasive techniques is to re orient anatomical perspective from a wide angle and top-down view of traditional open surgery to a narrow tubular vision from an angle. The authors have had prior laparoscopic expertise for all the procedures performed on the robotic platform in this study. The 3D view of the surgeon's console gives the operating surgeon an immersive experience. The magnified view of abdominal anatomy in robotic surgery along with superior abilities in doing fine dissections enhanced our anatomical knowledge and translated back into open surgery too. Difficult to visualize structures like pelvic nerves could be easily traced and saved while the stable visualization allowed a deeper understanding of the relationships of various structures.

Patient position challenges

The ability to change positions of the patient along with the freedom to add ports and the speed with which instrument changes can be done in laparoscopy is curtailed in robotic surgeries. Prior precise planning of port position is important highlighting the need for strong and dedicated mentorship to reduce errors.

On the same note, due to fixed position of the patient (Figure 5), presence of bulky equipment all around, necessitates the anesthetist to be more prepared and probably need to organize themselves for possible contingencies. Extreme positioning of the patient and its associated challenges are similar to laparoscopy.

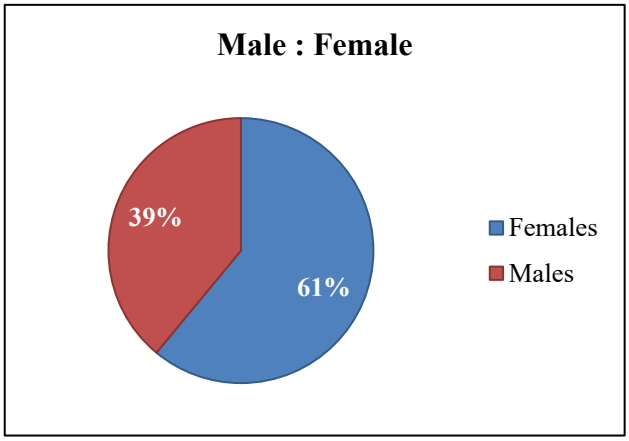

Figure 1: Male:female proportion.

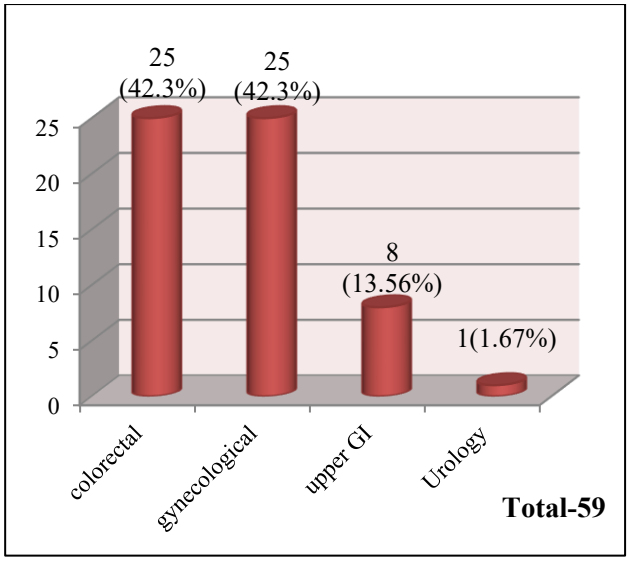

Figure 2: Depicting the proportion of various surgeries performed at our institute.

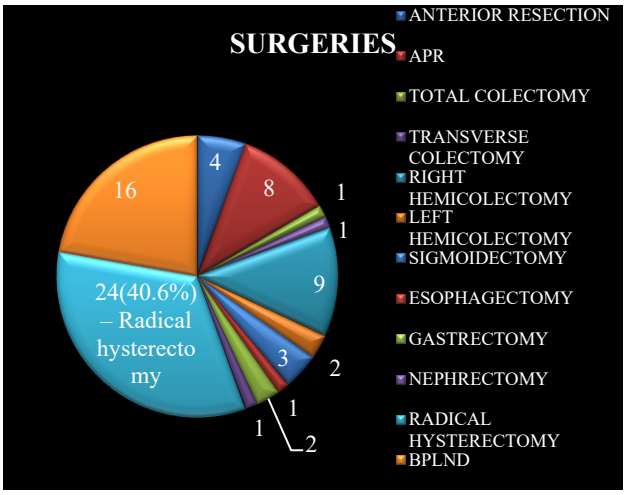

Figure 3: Depicting the proportion of individual surgeries.

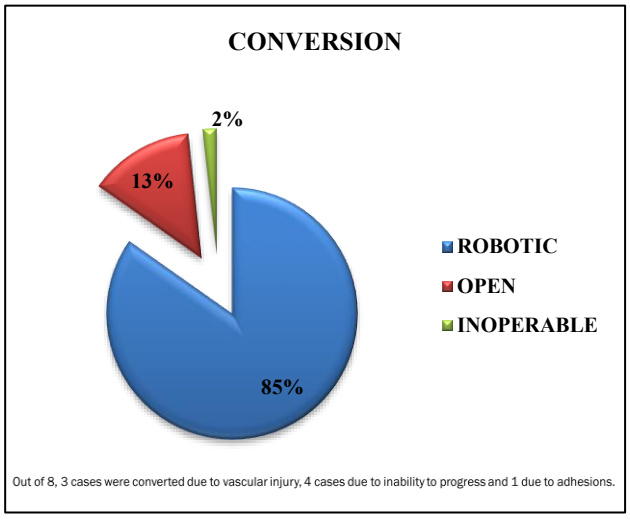

Figure 4: The robotic to open conversion rates.

Figure 5: Various patients positions in robotic surgery.

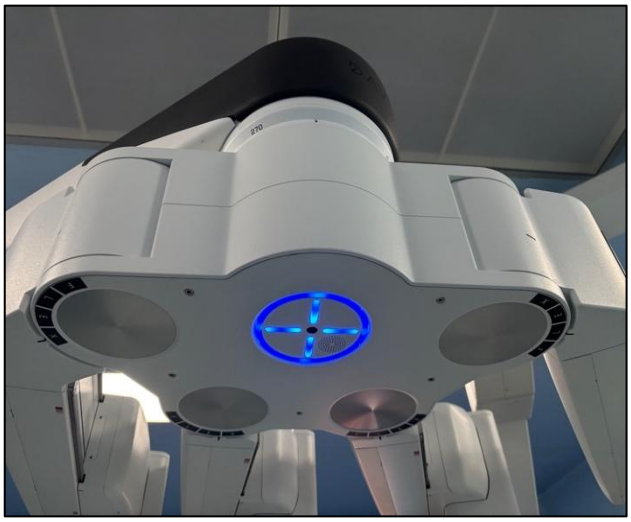

Figure 6: Laser light in the patient cart.

Figure 7: Using a lap instrument to facilitate robo instrument insertion.

Figure 8: Oblique position of the patient cart to facilitate the assistant surgeon.

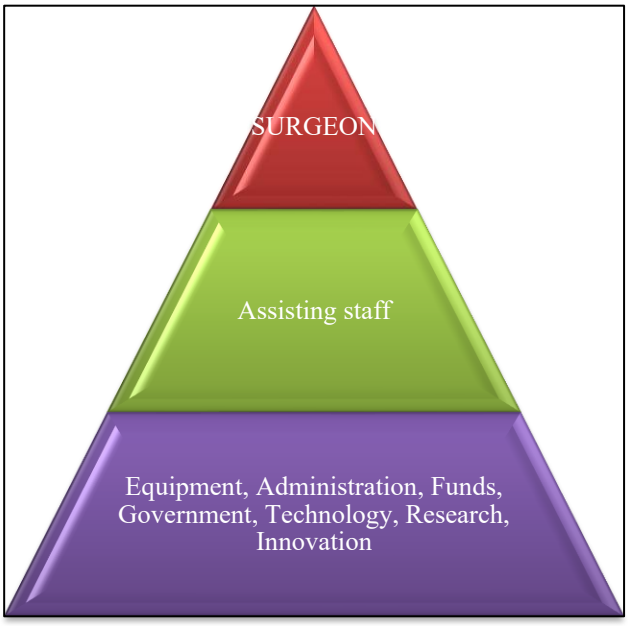

Figure 9: Depicting the pyramid of any surgical mode.

Training on the Platform

Robotic platform is an enhancement tool that multiplies the prior expertise in open and laparoscopic surgery in delivering superior surgical outcomes. The extreme magnification and depth perception compensates for the absence of haptics and surgery is performed using visual cues. These learnings can be further refined during conferences, at specific robotic surgery training centers, books, online articles and YouTube videos. For a well-trained robotic surgeon, the robotic instruments become an extension of their arms. A clear sign of mastery on the instrument would be an ability to apply clutch and camera pedal appropriately and aptly to allow seamless surgery.

Port planning

Well-planned ports would allow proper visualization of the target, comfortable reach and dexterity of the operative instruments and also would prevent internal clashing of the instruments. The vendor support manual predominantly showcases port positions for various surgeries in a straight line but a degree of re arrangement is required based on the habitus of the patient and surgeon's comfort. One such rearrangement done by the authors is to space the Arm 1 and 2 more than prescribed to give access to the laparoscopic port used for suction and retraction by the bed side surgeon during Hysterectomies. One needs to visualize the operative space and the ports need to be planned around 15-18 cm from the target anatomy. This mindset helps us assess the range of motion needed and thus can help us with appropriate port positioning.

Docking

Purpose of Docking is to properly align the robotic arms so that there is no clash of instruments externally. The auto mode of docking of the Davinci is found useful in most standard situations but it might become necessary to make a manual docking too with the help of the laser light in the patient cart (Figure 6) and the authors advise proficiency in the manual mode.

Implementation challenges

Intraoperative period

The long duration between induction to actual incision is much longer compared to laparoscopy but with experience this can be brought down as shown in our data. Robotic instruments are extra-long and there is excellent articulation at the tip of the instrument. The curved placement of ports to facilitate human arm ergonomics in traditional laparoscopy is not needed in robot and ports can be placed in a straight line.

Authors found the suggestion given by the vendor to visualize the ports by manipulating the camera before introducing the robot instruments is cumbersome. Instead, we found the introduction of a lap instrument (Figure 7) and position it towards the target would make the subsequent introduction of the bulky robot instrument a breeze. This is necessary as blind placement of the Robot instruments which are driven by the machine would use considerable force and without haptics can lead to serious injuries of the organs.

The suction cannula used by the assistant needs to be bariatric and sometimes even this may not be adequate due to the bulge of the sacral promontory in APR surgery. We would introduce the ryles tube through the

suction cannula and the surgeon positions the tube close to the area to be cleared by suction. An oblique positioning of the patient cart (Figure 8) can give more space for the surgeon to assist at the bedside. A secondary screen eases the challenges of the bed side surgeon as is the annotation feature for training.

Hitching the uterus during radical hysterectomie keeps the cadiere's retractor available for other activities during surgery. The movements of the assistant instruments can be challenging as the camera is under the surgeon's control.

Having an instrument cart ready for open surgery is a necessity and the authors handled vascular injuries using laparoscopic port while the robot is undocked and abdomen is opened for securing the bleeder. We experienced cable breakage of the robot instruments with instruments tip locked in flexed position making it difficult to extract. Instrument maintenance is of utmost priority and plastic sheath of monopolar scissors needs regular attention.

Robotic vs laparoscopy

Observation and assimilation of consultant's skill is easier compared to laparoscopy Trainees involvement in surgery is more in laparoscopy as they would be handling the camera or assisting with lap instruments making the Robotic surgery detached and communication less natural.

Table 1: Age distribution.

Age range (years)	23 – 72 years	
21-30	3	5
31-40	13	22
41-50	15	25.5
51-60	17	28.8 (Most common)
61-70	10	17
71-80	1	1.7

DISCUSSION

The surgical trend once shifted from open to laparoscopy, is believed to be shifting from laparoscopy to robotic surgery. But in fact, it is not actually a shift since robotic surgery is also a minimally invasive surgery but done by using more ergonomic instruments. Figure 9 shows the pyramid of any surgical mode where the surgeon is on the top of the pyramid with many factors forming the base. In comparison to other modes robotic surgery must have a strong base.

Mastering robotic surgery involves two aspects. Revisualizing the anatomy from a different perspective and understanding and mastering the instrumentation of the robot.[10] Traditional description of the anatomy is as visualized by the human eye which has a wide field of view and predominantly top-down view. And most surgeons start their training in open traditional surgery which matches with traditional anatomical descriptions. Minimally invasive surgery whether done by Laparoscopy or Robotically, the anatomy is viewed through a telescope that predominantly is an angled view and not top down.[11] Though laparoscopy offers better vision in a narrow space the view is telescopic (tubular) with a narrow field. This creates anxiety to the learning surgeon as he is unaware of the anatomy beyond the tubular vision especially when operating in pelvis. Overcoming this would be the biggest challenge for an open surgeon transforming into a robotic surgeon. The authors have their experience predominantly on the Da Vinci Xi system and the vendor has a very structured program that effectively trains the trainee on the various tools available on the console. The training software allows quantification of the skills to facilitate audit and crucial feedback for improvement.

Successful implementation of the Robotic program needs a motivated and well-trained team. The Primary surgeon needs to take up the leadership position to ensure proper role allotment among the OT Technician who handles the patient cart, the nursing staff who organize the instruments while the surgical team ensures coordination and planning for the docking and execution.

Docking times have decreased dramatically as we reached 59th surgery as the understanding of the ergonomics of the instrument improved and best possible orientation of the patient cart vis a vis to our local operation theatre design is learnt.

Port position

One of the biggest learning for us has been the planning for ports and it took us some time to realize that unlike Laparoscopy the ports need to be in straight line in Xi system. The curving of the port line in Laparoscopy is required to compensate for the relatively short length of instruments and ergonomics of human arms. In robot, the length of the instruments and articulation of the end wrist compensates effectively.

The need to achieve competence in minimally invasive surgery is well established and a necessity for all current and future surgeons. Due to capital costs, robot platforms currently might not be available in all teaching institutions. With increasing availability of competing platforms on the market, it is in near future that robot would be omnipresent. Hence no stone should be unturned by the trainee surgeons to master the robotic platforms.

The authors reaffirm the significance of the prior laparoscopic experience and mastering the visual motor axis challenges of laparoscopy on an Endo trainer should not be underestimated. Well-rounded anatomical knowledge obviously is an asset for any form of surgery.

How to encourage robotic training for trainees in residency program

Role of consultants

Consultants should inculcate interest in trainees to assist robotic surgeries by acquiring and displaying their skills while performing surgeries. Staged training like giving them chance to insert ports, dock, undock, assisting at patient's console, giving them opportunity to sit in the 2nd surgeons console for few procedures and finally making them perform the surgery under supervision can give them confidence.

The authors believe minimally invasive techniques, particularly robotic platforms have a strong role in improving the overall quality of surgery due to easier and better teaching opportunities to the juniors.

Role of the institute and administration

Install a robotic setup. Send trainees for robotic training, provide essentials equipment when needed. Include a well-structured robotic training program in the resident curriculum.

The days of "See one, Do One and Teach One" of halstadean principles are gone. Digital instruments like robot have given us ability to capture data intraoperatively on various metrics. So now we can quantify the surgeon's performance and relate that to outcomes. The trainings can be optimized due to data analytics. Like laparoscopic surgeries, robotic procedures also need a dynamic team leader (Surgeon) to take charge, guide, drive and mentor the team to benefit from the immense potential of the robotic platform in facilitating precise surgeries. The mindset of the surgeon needs to change as today Operation Theatre's are not the traditional surgeon centric environments. Surgeon is one member of the team with extra responsibilities.

The future is of minimally invasive surgery and robotic platforms are an extension of laparoscopic technologies. Unless we hop on to this disrupting technology, else one would be lost to the profession. Current robotic technologies need lot of space for their instruments to work with the pivot at the skin surface. The space is currently being created by the gaseous distension and such cannot be achieved in rigid structures like cranium. Steerable and flexible instruments would probably solve this challenge.

CONCLUSION

Surgeons need not unlearn certain skills of Laparoscopic Surgery to transform into Robotic Surgeons and in fact, prior laparoscopic experience is a favorable qualification. Robotic trainees need to realise that the mastery of the machine is the key while the foundations of anatomy and surgery remain the same.

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