Robotic Surgery in Oncology

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Robotic surgery is a novel technology in minimally invasive surgery which is becoming more popular among surgeons and patients. It helps the surgeons in operating inaccessible areas of human body with ease, in comparison to traditional open surgical techniques and laparoscopy. Patients are being benefitted by minimal scar, reduced blood loss, early recovery, minimum wound-related complications, and reduced hospital stay [1].

Robotic surgery got FDA approval in the year 2000. Initially, it was used in prostatectomy, hysterectomy, general surgical procedures, and minimally invasive cardiac valve repairs. Slowly the use of robotics was approved for surgeries of cancers involving inaccessible anatomical locations. This has led to the use of robotics in cancer surgeries all over the world in the last decade. Presently, cancer affecting prostate, bladder, kidney, rectum, endometrium, cervix, esophagus, mediastinal tumor, small wedge excision, metastatectomy, and lobectomy of lungs is being done. Initial success with respect to feasibility prompted the use of robotics in hepatobiliary, gastric, pharyngeal, and base of tongue cancers [2].

Pros and Cons

The advantage of robotic surgery is three-dimensional (3D) vision with magnification and stable operating field which aid the surgeon to visualize complex anatomical area and dissect carefully to minimize injury to critical structures to improve functional outcomes. Also enhanced dexterity and endo-wrist movement make dissection and lymphadenectomy better. Scaling of motion and improved ergonomics make prolonged procedures safe with improved accuracy. Because of these reasons, the patient will have better post-op recovery,

improved functional outcomes without compromising the oncological principles. However, there are some disadvantages in robotic surgery, such as anesthetic challenges because of the extreme positions, lack of haptic feedback which may result in cutting through the tumor, increased duration of the surgery, and the increased cost incurred [3].

Evidence

Unlike the use of robotics in benign conditions, the use in cancer surgery is different. It poses different questions like whether the early advantages have compromised long-term benefits and also whether the surgery cost has become a burden on patient, compromising the adjuvant treatment. Both these defeat the very purpose of treatment in cancer. As far as evidence is concerned, there are systematic reviews and meta-analyses regarding the feasibility, oncological safety, learning curve, and functional outcomes. Presently all the studies have shown comparable short-term outcome, less conversion rate, and marginal benefit of robotic surgery in carcinoma rectum and esophagus [4, 5]. Same is true for nerve sparing radical prostatectomy and nephron sparing nephrectomy. In all other cancers, the results are equivalent to laparoscopy [6, 7]. But in carcinoma cervix and carcinoma bladder, studies have raised alarm of poor long-term outcomes in minimally invasive surgeries [8, 9].

Robotic surgeries in cancer with definitive advantage in terms of ease of surgery and marginal benefits in patient outcome are:

- Anterior resection or APR with TME and ANP in carcinoma rectum [4]
- Nerve sparing prostatectomy in carcinoma prostate [10]
- Partial nephrectomy [11]
- Mediastinal tumors [12]
- Metastatectomy in the lung, wedge resection, and lobectomy in carcinoma lung [13]

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- Transoral robotic surgery (TORS) for small pharyngeal wall tumors, tongue base malignancy (avoids mandibulotomy) [14]
- Surgery for carcinoma endometrium [15]

Though many other procedures are being done robotically, the advantage is not clearly demonstrated with present evidence. However, continued effort and well-conducted studies to look into the long-term outcome may change the opinion in near future.

Barriers and Proposed Solutions

- Difference in opinion among surgeons involved in cancer care [16]
- High cost [3]
- Translation of immediate benefit resulting in long-term oncological outcomes [8]
- Suitability of robotics in advanced diseases

The first barrier can be addressed by inducing enthusiasm in young surgeons, supporting training, make uniform standards and evaluation, the results after reasonable learning curve. Second barrier is mainly market oriented and because of monopoly. Presently many more robotic systems are entering the market and may result in extreme reduction of cost, which is the need of the hour [17]. Third barrier is difficult to overcome unless surgeons involved in cancer care are open to the idea of robotic surgery, at the same time documenting their long-term outcome without bias. The last barrier is more of caution to robotic surgeons. Over enthusiasm in doing robotic surgery causing poor oncological outcome with no benefit should be condemned. A guideline of dos and don'ts would be of great benefit while using robotics in advanced cancer.

Indian Scenario

In India, 74 robotic equipments are made available by an older company and a new company which has come in existence for the last few months has installed 9 robotic systems [on personal communication]. To get trained in the said systems, the surgeons needed to go to another country earlier. In the past 3 years, three training centers have been established where the surgeons can undergo advanced robotic training either in live porcine models as made available in Yenepoya University Mangalore and Amrita University Kochi or in cadaver models as made available in MSR medical college in Bangalore. In cadaveric models obviously, bleeding would not be there, and this limitation could be overcome in the porcine model; the only drawback in that model would be a little different anatomy. Hand holding of the surgeons by more experienced

robotic surgeons as proctors is followed to overcome the initial inertia, complications, and avoidable conversions. Because of the intuitive movements available in these systems, the training period is said to be shorter. In India, esophageal surgery, lower GI surgery, gynecological surgery, and uro-oncological procedures have picked up. And the numbers are increasing every year. The financial considerations in the form of higher capital expenditure and operative expenditure, the number of robotic system installation is rather small for a country of more than 1 billion population. The reach to the community is rather less due to the above said reasons.

Conclusion

Robotic surgeries in cancer have shown promising early results regarding feasibility, oncological safety, and learning curve. However, long-term oncological outcome in patients who have undergone robotic surgery is not well studied. Comprehensive view to identify all technical, ethical, and legal issues should be considered in each patient for a favorable outcome.

Conformity is doing what everybody else is doing regardless of what is right
Morality is doing what is right regardless of what everybody else is doing

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