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ROBOTIC SURGERY HAS PROVEN ITSELF AS AN INDISPENSABLE EXTENSION OF GENITOURINARY SURGERIES--- A REVIEW ARTICLE

KEY WORDS: Robotic, learning curve, cost, complications.

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ABSTRACT

Robotic surgery evolved in an era of technically cumbersome laparoscopic surgery with its associated steep learning curve. The difficulty faced by laparoscopic surgeons in negotiating this learning curve led to the evolution of robotics. The real benefits of robotic surgery stem from the enhanced surgical precision, miniaturization of the incision, diminished blood loss, reduced pain, and more rapid convalescence. Other advantages of robotic-assisted laparoscopic surgery are the possibility of articulation beyond the normal limits of the human wrist and three-dimensional stereoscopic vision with higher magnification. The advantages of robot assistance with regard to many ablative and reconstructive uro-surgical procedures are too numerous for urologists to ignore, and some of these are discussed later in this review. However, the long-term benefits of robotic assistance in urological laparoscopic surgery (other than in robot-assisted radical prostatectomy) and the associated cost utility issues remain to be ascertained.

INTRODUCTION

Robotic surgery enables us with high definition images, enhanced endo-wrist dexterity, precise hand-eye coordination and physiological tremor filtering. "Robot" has been derived from a Czech word "Robota". It was Rossum's Universal Robots (RUR), a 1921 Czech play by Karel Capek, where he introduced us to the potentials of robots which helped human masters with day to day activities. These robots then revolted to seek world domination. How prophetic it proved when almost a century later robotic system have begun to dominate the surgical landscape in urology!

Robotic Radical Prostatectomy (RRP)

Today more than 80% of the radical prostatectomy are undertaken with the help of robots. The main benefit over the laparoscopic arm is the shorter learning curve. RRP is the perfect marriage of minimally invasive and magnified advantage of Laparoscopic radical prostatectomy with the dexterity of an open procedure.

In a couple of randomised control trials by Asimakopoulos AD et al. and Porpiglia F et al, robotic arm was shown to have a favourable short and long term urinary continence and erectile function.[1,2] From a couple of systemic review and meta-analysis by Seo HJ and Pan XW, comparing robot assisted radical prostatectomy(RARP) and open radical prostatectomy, we find a significant improvement in 12 months incontinence rates(7.6% vs 12%) and potency rates (60% vs 48%) in favour of RARP. There was no difference in positive margins or biochemical recurrence rates.[3,4]

In a comparative study with open radical prostatectomy by Trinh QD et al, there was significantly lower blood transfusion and overall complication rates and shorter length of hospital stay but no difference in mortality.[5]

Robotic Radical Cystectomy

More than quarter of the radical cystectomy worldwide are performed robotically. In a multicentre study from the International robotic cystectomy consortium(IRCC) by Johar RS et al, there was 19% clavien grade ≥ 3 complications.[6] Another study on the proficiency of lymphadenectomy from IRCC by Hellenthal NJ et al, showed comparable results with open radical cystectomy.[7]

In another study by Bochner BH et al., 90 day clavien grade 2-5 complication was similar in robotic and open arm.[8] An update from the RAZOR trial by Smith ND et al, also pointed out to the significantly lower blood loss and blood transfusion rate in robotic cohort.[9]

Robotic Partial Nephrectomy

The first robot assisted partial nephrectomy was performed in 2004. More than 47% of the partial nephrectomy worldwide are performed today with the help of robots. The main challenge of laparoscopic partial nephrectomy(LPN) is the ability to perform an effective renorrhaphy within the warm ischemia time. LPN is a challenging procedure even in the hands of high volume experts. In a review article by Laviana AA et al, robot assisted partial nephrectomy (RARN) had a significantly lower learning curve compared to LPN (15-25 cases compared to 100-150 for LPN).[10]

In a meta-analysis by Leow JJ et al, RARN was performed for larger and more complex renal masses with lower conversion rate to open procedure, warm ischemia time and overall major complication rates.[11]

Other robotic procedures in urology

In a systemic review and meta-analysis by Autorino R et al, robotic assisted arm had shorter learning curve, enhanced tissue manipulation and improved visualisation comparted to laparoscopic repair of ureteropelvic junction obstruction.[12] Another systemic review comparing robotic and laparoscopic pyeloplasty by Braga LHP et al, also showed lower analgesic requirement and decreased length of hospital stay in the robotic arm.[13]

In a multi-institutional experience by Abaza R et al, robot assisted radical nephrectomy facilitated vena cava thrombectomy and complex nephrectomies.[14]

Robot assisted radical nephroureterectomy (RARNU) due to its improved dexterity facilitated improved distal ureteric dissection, bladder closure and better vision for potential lymph node dissection.

By the technique of modified paramedian line port placement as illustrated by Lee Z et al, re-docking is not necessary, thus enabling single stage pure robotic nephroureterectomy.[15] **[Fig 1]**

In a systemic review comparing laparoscopic and robotic nephro-ureterectomy by Stonier T et al, both had equivalent perioperative and oncological outcomes and lower postoperative mortality and complication rate in robotic arm.[16]

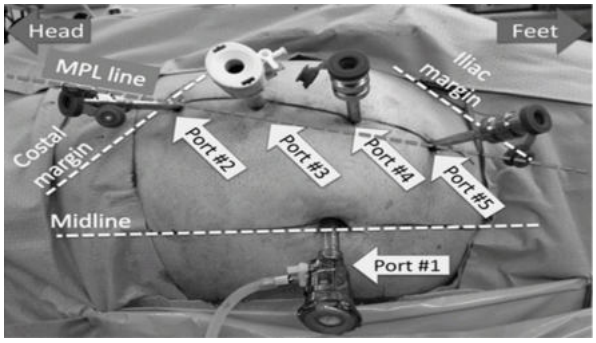

Fig 1: MODIFIED PARAMEDIAN LINE PORT PLACEMENT FOR RARNU

The first robotic ureteral re-implantation was reported in 2004. The first robotic ureterolysis with omental wrap was performed in 2006. Although series are relatively small, they do appear to show lower morbidity – with similar success rates to the open approach. Robotic cystoplasty has been reported, with similar outcomes to open approach.

The robotic approach has also been used for simple prostatectomy (RASP), with the first report in 2008. The magnified 3D view that the robotic system offers, helps perform a variety of microsurgical procedures, including varicocelectomy, vasectomy reversal, spermatic cord denervation and testicular sperm extraction.

The Future

Raven-II is an interactive platform where visionaries from all over the world share their ideas to expand the horizons of robotic surgeries like two surgeons operating on the same patient simultaneously and role in battlefield or underwater remote surgery.

Though robotic surgeries seem costly, a recent report by the Canadian agency for drug and technology in health stated that with increase in the annual caseload and increase in useful life of robot, the cost per patient decreases dramatically. There was also a significant increase in savings on hospital cost in robotic arm. **[Table 1]**

Table 1: INCREMENTAL SAVINGS IN HOSPITAL COSTS, BY INDICATIONS

PROCEDURE	ROBOTIC COMPARED WITH OPEN	ROBOTIC COMPARED TO LAPAROSCOPIC
PROSTATECTOMY	$3,714	$1,929
HYSTERECTOMY	$4,999	$310
CARDIAC SURGERY	$5,727	Not applicable
NEPHRECTOMY	$5,758	$1,427

The weighted incremental savings in hospital costs resulting from robotic surgery for an average patient was estimated to be $3,150 per procedure. The weighted per-patient savings for prostatectomy was $2,388 and for nephrectomy $3,653.

The Insurance regulatory and development authority of India (IRDAI), as per their notice on improvised guidelines on 1st of January,2020 has instructed all medical insurance companies to also cover robotic surgeries.
(https://www.irdai.gov.in/admincms/cms/uploadedfiles/Guidelines%20on%20Standard%20Individual%20Health%20Insurance%20Product.pdf)

CONCLUSION

Robotic surgery is the future of urology. Whether you love it or loathe it, robotic surgery now has an irreversible role in urology.

Funding
NIL

Conflict of Interest
NIL

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