

# Robot-assisted laparoscopic implantation of brachytherapy catheters in bladder cancer recent interests and prospective

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## Introduction

Bladder cancer is the most common cancer of the urinary tract. It is the ninth most commonly diagnosed cancer worldwide, with more than 380,000 new cases each year and more than 150,000 deaths per year (1). About 25% of the diagnosed cases present with muscle-invasive bladder cancer (MIBC) (2). Radical cystectomy (RC) and urinary diversion is considered the gold standard treatment for muscle-invasive urinary bladder cancer. RC is an extensive urological surgical procedure and despite improvements in practice, technology and post-operative care it is still associated with significant morbidity and mortality. Significant complications include such as erectile dysfunction, urinary leakage, urinary tract infection, loss of normal bladder function, and risk of death. It is associated with widely variable reported postoperative morbidity and mortality rates between 19% to 64% and 0.8% to 8.3%, respectively (3).

Over the last decade along with increasing approach of organ preservation in oncology across sites bladder-preserving strategies are getting prominence in selected cases. Optimal bladder-conserving treatment consists of a trimodal therapy of a safe maximum trans urethral resection of the bladder tumour followed by radiation therapy (RT) combined with concurrent radiotherapy sensitising chemotherapy. The intended cumulative [External beam radiotherapy (EBRT) and brachytherapy] radiotherapy dose for all schedules in terms of biological equivalent dose at 2

Gy/fraction (EQD2), is approximately 70 Gy (a/b ratio of 10–15 Gy) (4). Patients with low-volume T2 disease without hydronephrosis, extensive carcinoma *in situ* and tumors not located in the bladder neck or the prostatic urethra in male patients are the candidates of bladder preservation. Recent evidences are consistent about equivocal outcome of trimodal Bladder conservation therapy when compared with RC in properly selected cases (5-8).

Bladder cancer radiotherapy treatment is unique in that the treatment always includes EBRT with or without boost, as expected a boost of the tumor site can enable to deliver a higher dose. The first elective tumor volume always includes the whole bladder, however controversies exists on how to deliver the boost dose to the bladder. Due to less reproducible nature of the bladder volumes it is expected that external beam radiotherapy will be a dubious technique to deliver the boost dose. Delivering the brachytherapy boost is always a novel idea as it will be precisely delivering the intended dose at the accurate site with a steep dose gradient and lower toxicity of neighboring normal organs like the bowel, sigmoid, rectum, vagina, femoral heads, pelvic bones, and neural structures of the sacrum, and also the normal bladder tissue.

Bladder brachytherapy techniques dated back to the dates of Second World War, initial cases treated by radioactive needles and wires had high rates of severe late complications. Advent of after loading catheters and computer planning systems limited the adversities to

an acceptable limit. The implantation of brachytherapy catheters (BTCs) was traditionally performed via an open retropubic approach till the first decade of this century. With the popularity of laparoscopy surgery in bladder cancers the laparoscopy guided implantation started in 2009 and subsequently use of robots were also introduced in brachytherapy within few years as the laparoscopy procedures started using them (9). As expected bypassing the laparotomy by the laparoscopy techniques will cause less acute morbidities, early recovery from surgery and will also decrease late morbidities of surgery and radiotherapy like adhesions and its consequences. Laparoscopic techniques however have some technical limitations like two-dimensional imaging, restricted range of motion of the instruments, and poor ergonomic positioning of the surgeon. Emerging robotic methods provide undoubted technical advantages over conventional laparoscopy in terms of improved visualization and greater dexterity (10). They also have advancements like 3D imaging techniques, tremor filter, and articulated instruments (10).

### Recent studies of robotic brachytherapy

Very recently an article by Judith Bosschier in European urology gives a complete study of 30 eligible patients of whom 26 patients received robot performed interstitial brachytherapy in cancer urinary bladder (11). BTC implantation was successful in 92% of the patients, median hospitalisation was 5 days. The disease-free survival is 74% at 1 year, 63% at 2 years, and cystectomy free survival was 87% at 1 year. The authors have given a vivid picture of the implant procedure including an educational video. They concluded it is a technically feasible technique and is safe. However, the numbers of patients in this study were small (n=26), the follow up period is also limited. Besides it was a retrospective study with patient pooled from two different institutions with two different treatment protocols. It will be excellent if we get prospective update after few more years with more number of patients and outcome. We need meticulous preoperative investigation including a thorough metastatic work up before undertaking such procedures.

A study published at *J Contem Brachytherapy* in 2014 shows similar results in terms of hospital stay and ease of the procedure (9). That study however offers more technical explanation and evidence that the quality of implant by laparoscopic robotic technique is same as that of open method, besides the use of laparoscopic technique also reduces the hazards of tube blockage and repeated new

planning.

The same group published in the year 2016 a series of 57 patients treated by Da Vinci robotic laparoscopy after an initial experience of laparoscopy use. The median follow-up was 2 years. Using cumulative incidence competing risk analysis, the 2-year overall, disease-free, and disease specific survival and local control rates were 59%, 71%, 87%, and 82%, respectively (12).

### Discussion

All technologies are taken with a suspicion, besides effectiveness the other valid parameters are cost and the steepness of the learning curve of the technique. Metaanalysis done on use of robotic surgeries of abdomen point that they are equally effective in treating the complicated cases including malignancies, with comparative perioperative complications, the operating time generally is more but blood loss, hospital stay and conversion rates are less across many sites (10). Coming to the comparison in bladder cancer, updated systematic review and meta-analysis derives that robots are equally effective with less complications when compared to open surgeries of cystectomy (13). Robot assisted surgeries costs more for increased material costs and the increased operating time but they are less costly when the day of stay in hospital is taken in account (14,15). It may be that robot assisted laparoscopy procedures are actually more cost effective when the complications are considered. There are studies where conventional RC, robot assisted cystectomy and robot assisted brachytherapy (RAB) were compared the last was found to be least expensive (16).

RAB is available in only a few selected centres even in the western world (we can see the publications of laparoscopic and robotic brachytherapy are from a few selected centres only). We found an interesting article that RAB for bladder cancer has been guided by tele conferencing, so training in centres with baseline expertise in robotic surgery brachytherapy may not be that difficult (17). The Da Vinci robot manufactures have come with training facilities like dual consoles and simulators (18).

As we are discussing the importance of laparoscopy and robot guided brachytherapy in the bladder cancer more and experiences and guidelines are being published (19). The European Society for Radiotherapy and Oncology has recently published the guidelines of bladder cancer brachytherapy and it endorses the use of laparoscopes and robots in the use based on available evidences (4).

By principle brachytherapy is the ultimate form of conformal radiotherapy. Treatment by external beam radiotherapy had a leap in technological advancement both in planning and delivery, the progress of brachytherapy was relatively stagnant till 2000. May be the ongoing technological advancement can provide the platform for resurgence of use of brachytherapy. However, if these technical advancements will lead to improved clinical outcomes are still to be proved. As of now it is a timely published research on the use of robotic technique in the bladder cancer brachytherapy with comparable outcomes and no increased morbidity. With advancement of other technologies and surgical sciences we will have to move forward. It is well understood that with laparoscopy and cystoscopy procedure becoming the norm for bladder surgery, bladder brachytherapy needs to follow the same path for the implantation procedure keeping in pace with our surgical colleagues. This is evidenced by growing use of robots and laparoscopes in thoracic and prostate brachytherapy. Understanding the projected path and potentials of brachytherapy with robots needs to be explored, currently in the world nine centers are engaged in developing robotic systems for brachytherapy (20).

## Conclusions

In the present scenario the use of robots and advanced technology in brachytherapy is on raise. In bladder cancer the experience is limited but there are potential advantages of minimal blood loss and reduction of hospitalization time.

It is an effective, feasible, cost effective and a reproducible procedure. Its availability and expertise are limited but expansion of the art seems feasible. With its widespread use and results from further studies with more patients it will be clear, if the use of robots over simple laparoscopy just adds to the sophistication or is a more better way of doing what we were already doing.

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## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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