ROBOT-ASSISTED LAPAROSCOPIC RADICAL PROSTATECTOMY: A REVIEW OF TECHNIQUE AND OUTCOMES

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ABSTRACT

There has been an increase in the incidence of prostate cancer over time, and it now constitutes 15% of all male cancers in developed countries and 4% in developing countries. Radical prostatectomy is the gold-standard treatment choice in cases determined with organ-confined prostate cancer and life expectancy is >10 years. Currently in the USA, 80% of radical prostatectomy operations are robot-assisted. Although there is an additional financial burden in comparison with open surgery radical prostatectomy, the early recovery of functional status of continence and potency seem to be major advantages of the robotic method. However, there is clearly a need for future prospective studies of large patient series with longer follow-up to further clarify the financial issues, and the oncological and functional status.

Keywords: Prostate cancer, robot-assisted laparoscopic radical prostatectomy, trifecta.

INTRODUCTION

Prostate cancer is the most commonly seen solid neoplasm, and is the second most common cause of death in males in the USA. In 2015, approximately 220,800 individuals were diagnosed with prostate cancer and of those 27,540 were reported to have died from the disease.[1] Together with an increase in the incidence of prostate cancer over time, it constitutes 15% of all male cancers in developed countries and 4% in developing countries.[2] Since the introduction of the use of prostate specific antigen in clinics in 1987, the incidence of metastatic prostate cancer has been reduced and the incidence of organ-confined prostate cancer has significantly increased.[3]

Radical prostatectomy is the gold-standard treatment choice in cases determined with organ-confined prostate cancer and life expectancy is >10 years. The primary aim of the operation is to completely remove the tumour. However, significant attention must be given to the patient being able to postoperatively maintain an erection and continue life without urine leakage.[4] At the beginning of the 1980s, Walsh and Donker[5] first described radical retropubic prostatectomy. Although the oncological results were positive, the feeling was that there was a need for more minimally invasive methods because of perioperative complication rates or postoperative problems such as erectile dysfunction and incontinence. In the early 1990s, Schuessler et al.[6] described laparoscopic radical prostatectomy, although this did not come into widespread use because of difficulties in the technique and a long learning curve.

The introduction of the da Vinci robotic system, with its capacity for hand and wrist type movements, thereby eliminating surgeon hand tremor, provided the possibility of successful surgical dissection and anastomosis; the system allows the ability to work in a more sensitive three-dimensional environment and thus it has been possible to reduce the difficulties of the complex laparoscopic method.[7,8] The first robot-assisted laparoscopic radical prostatectomy was performed by Binder and Kramer[9] in 2000. In 2001 they published the results of 10 cases of robot-assisted laparoscopic

radical prostatectomy. Since then, the use of the da Vinci robotic system has become rapidly widespread. Currently in the USA, 80% of radical prostatectomy operations are robot-assisted.[10]

COMPLICATIONS

Early and late-stage complications may be seen following a radical prostatectomy. Early complications include bleeding, ureteral injury, intestinal injury, deep vein thrombosis, myocardial infarction, pulmonary embolism, and death. Late complications are incontinence, erectile dysfunction, and anastomotic stenosis.[11,12] Many studies have evaluated the perioperative and postoperative complication rates of radical prostatectomy after the development of minimally invasive surgery and have compared these with open procedures. The mean total complication rate in the minimally invasive robotic procedure has been shown to be lower.[13-15] In a study of 20,000 cases, which compared the robotic method with the open method, the former was shown to be advantageous in all the perioperative data.[16]

Some authors have reported significant advantages of minimally invasive surgery compared with open procedures, especially with respect to perioperative bleeding and postoperative transfusion rates.[17-19] It has been emphasised that this advantage can be attributed to a better and more detailed view provided by the magnified image of the laparoscopic camera in the minimally invasive method and the suppression of bleeding, especially venous leakage, due to the tamponade effects produced by the formation of a pneumoperitoneum.[17,18] Similarly in a meta-analysis by Novara et al.,[20] all the perioperative complication rates were reported to be lower in robotic surgery than in open surgery, although statistically significant differences were only observed in the amount of blood loss and blood transfusion rates. Another important perioperative statistic is the operating time.

When it is considered that the patient is in the maximum Trendelenburg position in the robotic procedure, the operating time is of greater importance. Sugihara et al.[15] compared robotic radical prostatectomy with both open surgery and laparoscopic surgery, which showed that the duration of anaesthesia was 42.6% and 6.9% longer than in the other two methods, respectively. However, this prolonged period of anaesthesia was not reported to increase the complication rates. Recent studies have shown that with the widespread use of the robotic system and completion of the learning curve by surgeons, operating times have significantly reduced and have been shown to be similar to those of open surgery. In their meta-analysis Novara et al.[20] reported that operating times are similar between open and robotic assisted radical prostatectomy, with the latter taking around 2.5 hours. When the duration of hospital stay is evaluated, some studies have reported a shorter hospital stay of patients with the robotic procedure.[16,20-22] In contrast, in some centres that have adopted the open procedure as routine, duration of hospital stay has been shown to be similar to that of the robotic procedure.[23] However, rather than an evaluation of the differences in length of hospital stay, there is a need for extensive studies evaluating functional outcomes such as the time of return to work and physical activities of the patients.

ONCOLOGICAL RESULTS

The primary aim of treatment, which is of greater importance than morbidity following radical prostatectomy, is the oncological outcome. The two most important parameters in the oncological follow-up of radical prostatectomy are a positive surgical margin and biochemical recurrence status.

The status of a positive surgical margin after radical prostatectomy is accepted as an independent risk factor in the prediction of recurrence of the disease.[24,25] As the robotic method has no haptic feedback, some surgeons speculated that this technique could increase the rate of positive surgical margin. However, studies of the robotic method have shown that it has not increased the rate of positive surgical margin. To eliminate these uncertainties, studies have been conducted comparing the robotic method with both open and laparoscopic radical prostatectomy and the rates of positive surgical margin have been observed to be similar to the other two methods.[26-30] However, authors critical of these studies have stated that patients selected for the robotic procedure were generally low-risk prostate cancer patients and the results could be different with a high-risk group. In 2013 Yuh et al.[31] published a systematic review of 12 studies including 1,360 high-risk patients managed with robotic prostatectomy and reported an average postive margin rate of 35% (range: 12–53%).

Studies using prostate specific antigen as a marker of biochemical recurrence have demonstrated that robotic prostatectomy does not increase biochemical recurrence rate when compared to the open technique. Although there are not as many long-term follow-up studies looking at the robotic method it can still be safely used, even in high-risk patients.[32,33] Menon et al.[34] presented the robot-assisted laparoscopic radical prostatectomy results of a single-centre study with a mean 5-year follow-up of approximately 1,400 patients and biochemical recurrence rates were observed to be similar to those of open surgery at 10%.

FUNCTIONAL RESULTS

Despite the good primary target oncological results after radical prostatectomy, the postoperative functional outcomes are of great concern to the patient, particularly incontinence and potency.

Urine leakage after radical prostatectomy is a troublesome condition. Therefore, studies comparing the robotic procedure with other methods have sought to answer the question of whether it can provide better incontinence results.[17,35-38] In these studies, the mean continence rates in the robotic procedure have generally been in the range of 90–95%. In a review by Coelho et al.,[17] continence was accepted as patients using one continence pad at most per day, and at the end of 1 year the continence rates were reported as 79% in the open method, 84.8% in the laparoscopic method, and 92% in the robotic method. Some studies have compared the open, laparoscopic, and robotic techniques and have observed no statistically significant difference between them in respect of incontinence rates[39] while others have stressed that the main advantage of the robotic method over others is the improved early continence status.[37,38] Although there are some conflicting data it seems likely that robotic surgery may provide some advantage in regaining continence early compared with other methods, particularly open surgery. However, it must not be forgotten that there are other factors affecting continence, such as the patient's age, the preoperative continence status, and the experience of the surgeon.

Erectile dysfunction is another problem which could develop postoperatively following radical prostatectomy. Therefore, since the time that radical prostatectomy was accepted as the gold-standard treatment for local prostate cancer, there has been the consideration of how erectile function can be better preserved and studies have been conducted on this subject. Walsh and Donker[5] first stated that the neurovascular bundle could only be seen in the posterolateral to the prostate. However, later studies showed that with the growth of the prostate in the fetus and neonates, a different course was seen of this location with distribution towards the lateral surface.[40] Eventually, many authors reached a consensus that nerve distribution was in the 2 and 10 o'clock positions on the prostate lateral surfaces; two-thirds of the prostate lateral surface nerves were in the posterolateral and one-third were in the anterolateral surface.[40-46] It was concluded that in nerve preserving radical prostatectomy, it was necessary to make the fascia incision more anterior at the level of 2–10 rather than at the level of 4–8. In this context, in the study by Savera et al.,[43] high anterior release was applied to patients in robotic radical prostatectomy and very good results were obtained.

As use of the robotic system has the advantages of three-dimensional, high-quality, detailed imaging, it facilitates protection of the neurovascular bundle. Various studies have compared the results of robot-assisted radical prostatectomy with both open and laparoscopic methods and have obtained better potency rates with the robotic method.[26,27,32,35,47] Hakimi et al.[35] presented the bilateral nerve protection results of radical prostatectomy performed laparoscopically and with the robotic method, and at the end of 1 year the potency rates were observed to be 71% and 77%, respectively.[35] Two other studies also emphasised better 1-year potency rates from the robotic procedure compared with the laparoscopic method.[27,32] Several authors have suggested that the observed improvements in early potency are due to the ability to perform more accurate nerve-protective surgery with the robotic method.[26,48] However, in some studies which have evaluated the quality of life of patients after radical prostatectomy, no significant differences have been observed between the open and robotic method in respect of sexual functions at the end of 1 year.[49]

Similarly, in a survey by Barry et al.,[50] an extensive investigation was made into potency and continence after radical prostatectomy and no significant differences were found between open and robotic methods. In conclusion, it is unclear whether better potency results are obtained following a robotic procedure. However, in the preoperative evaluation, factors that could affect

the potency rates must be taken into consideration, such as the disease stage, the patient's age, concomitant diseases (diabetes, etc.), the experience of the surgeon, and the surgical technique (intrafascial, interfascial). Patients must be informed accordingly before the operation and the expectations must be presented by stating the risks of what could occur postoperatively. Thus, the patient can avoid disappointment in the postoperative period.

COSTS

The additional cost of the robotic procedure is without a doubt its greatest disadvantage. In a systematic review by Tandogdu et al.[51] in 2015 evaluating the economic burden of the robotic system, it was emphasised that the average costs of robotic radical prostatectomy were higher than those of both the open and laparoscopic methods. The cost ranges were stated as $7,504–$9,737, $4,931–$10,567, and $6,320–$10,991, respectively. In another study conducted in Japan comparing the robotic procedure with other methods, the robotic radical prostatectomy and open method was reported to be 53% and 13.2% more costly than the laparoscopic method, respectively.[15] In a broad-based study in the USA, it was concluded that despite the shorter hospital stay and lower complication rates of robotic radical prostatectomy compared to the open method, the total hospital costs were greater ($11,932 versus $9,390).[52] In contrast, some authors have stressed that with experienced surgeons working in centres performing high numbers of robotic radical prostatectomy, this cost difference can be reduced to a minimal level.[53,54]

CONCLUSION

The use of minimally invasive robotic radical prostatectomy continues to increase. Previous studies have reported pleasing oncological results with the use of the minimally invasive robotic radical prostatectomy even in cases of advanced prostate cancer. Although there is an additional financial burden, in comparison with open surgery radical prostatectomy, the robotic method may provide some advantages in terms of functional outcomes such as continence and potency. However, there is clearly a need for future prospective studies of large patient series with longer follow-up to further clarify the financial issues and the oncological and functional outcomes.

Another important point is that preoperative evaluation must be applied to patients (the stage of disease, comorbidities, etc.) and they must accordingly be informed in detail of what to expect postoperatively. Thus, patients will not have unrealistic expectations and will avoid the possibility of disappointment.

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