Robotic Prostatectomy in 2014: Current Status, and Future Trends Ash Tewari, MD and others, 2014

INTRODUCTION:
Prostate cancer (CaP) is the most commonly diagnosed solid organ tumor in men in the United States. It is estimated that 250,000 men will be diagnosed and approximately 30,000 will die from the disease this year[1]. Prostate Specific Antigen (PSA) screening has led to stage migration of the disease; that is an increasing number of men are presenting with cancers that are confined to the prostate versus their historical counterparts. Currently, robotic prostatectomy is the most common surgical treatment modality for localized prostate cancer in the United States. Radical prostatectomy offers an excellent potential for cure, with cancer specific survival of 93% to 95%[2]. In this article we detail our current prostate staging protocol along with a review of the literature as it relates to robotic prostatectomy outcomes.

PREOPERATIVE WORKFLOW: OUR CURRENT APPROACH
Transrectal ultrasound (TRUS) guided biopsy uses ultrasonic vision to guide at least 10 or more biopsy cores in patients with suspected prostate cancer. The limitations of transrectal biopsy are well described in the literature. Annually, nearly a million biopsies are performed in the US. A majority of cancers detected on TRUS biopsy in a screening population, will most likely not be clinically relevant disease [3].

Our clinic utilizes MRI-TRUS fusion, where an MRI image of the prostate is obtained prior to biopsy. Firstly, a multiparametric MRI of the prostate is performed. The radiologist will perform a standard reading of the MRI and identify regions of interest. This image is loaded onto a workstation where specific targets of the prostate can be identified. The biopsy needle location is co-registered with the MRI and specific targets of the prostate are taken. This approach offers several advantages in the active surveillance setting as well as the pre-prostatectomy setting (Figure 1).

**Figure 1:** MRI-Fusion with planned biopsy targets

**The Steps to undergo a MRI-Fusion Biopsy**

1. The prostate is scanned – Using a standard ultrasound connected to the fusion device; a 360-degree scan of the
prostate is performed. This image is converted into a real-
time 3D along with views in different planes (coronal, 
transverse, and sagittal). Image segmentation calculates the 
prostate gland boundaries and the prostate volume.
2. Biopsy Planning – Using MRI images, targets of interest 
where prostate cancer lesions are believed to exist are 
identified. If the patient has had a previous biopsy, we are 
able to input previous biopsy plans to locate where previous 
biopsy cores were taken. This plan can be used to revisit a 
positive core from a previous procedure to monitor disease 
progression in cases of active surveillance.
3. Biopsy – Using real-time biopsy needle tracking 
capabilities, we are able to accurately place the needle. The 
biopsy needle is placed into the prostate and a core is taken.
4. Reporting – We generate a report with images from the 
biopsy. This includes measurements made during the biopsies, 
such as linear measurements, prostate volume, etc. The report 
also includes type of plan and other navigational data.
An initial study utilizing fusion biopsy in 171 patients who 
underwent the procedure, investigated 106 patients 
under active surveillance for confirmed CaP, and 65 patients 
with increasing PSA, prior negative conventional biopsy CaP 
was detected in 53% of all men. MR-TRUS fusion biopsy based 
targeted cores had higher yield of 21% as compared to 7% for 
systemic biopsy cores. Moreover, a higher number of Gleason 7 
cores (36% vs. 24%) were detected [4].

RISK STRATIFIED GRADES OF NERVE SPARING
Nerve sparing (NS) has been found to be independently 
associated with post-operative recovery of erectile 
functioning in prostatectomy patients. Various approaches to 
NS technique have been described in the literature. This 
includes cautery-free [5], where no thermal energy is used 
during the dissection of the neurovascular bundle. Different 
planes of dissection have also been described, such as the 
“Veil of Aphrodite”, where dissection of the prostatic fascia 
is carried to the prostatic surface, and the periprostatic
tissue is released in an avascular plane [6]. Finally, a clipless technique was also described [7].

Our risk stratified approach to athermal, traction free NS during robotic radical prostatectomy is based on the patient’s preoperative findings, which predict extra-prostatic extension (EPE). This preoperative decision making model incorporates serum PSA level, clinical stage, digital rectal exam findings, biopsy Gleason score and MRI findings. This workflow strives to optimize the competing goals of cancer control and preservation of continence and potency by varying degrees of preservation of the nerve fibers in different fascial planes (Figure 2) [8] [9]. These degrees of preservation are described as follows:

Figure 2.

**Grade 1 NS [nerve sparing]**: The Denonvilliers’ fascia and the lateral prostatic fascia (LPF) are incised just outside the prostatic capsule to preserve the neural hammock. We also describe this as medial venous plane for complete hammock preservation. This is the greatest degree of NS possible, and we perform this procedure for patients with no-to-minimal risk of extra prostatic extension (EPE).
**Grade 2 NS:** The Denonvilliers’ fascia (leaving deeper layers on the rectum) and LPF are incised just outside the layer of veins of the prostate capsule. This allows the preservation of most large neural trunks and ganglia and is used for patients at low risk of EPE.

**Grade 3 NS (partial/incremental):** An incision is made through the outer compartment of the LPF (leaving some yellow adipose and neural tissue on the specimen), excising all layers of Denonvilliers’ fascia. This is performed for patients with moderate risk of EPE because some of the medial trunks are sacrificed, whereas the lateral trunks are preserved.

**Grade 4 NS (non-NS):** These patients have a high risk of EPE and are not candidates for NS. In such cases, we perform a wide excision of the LPF and Denonvilliers’ fascia containing most of the peri-prostatic neurovascular tissue. In selected patients, we attempt nerve advancement of the identifiable ends of the neurovascular bundle.

These planes are developed athermally (no use of thermal energy) by sharp and blunt dissection, proceeding distally toward the apex and laterally on both sides. At the lateral attachments, the perforating arteries enter into the prostatic capsule. They are sharply cut after being secured by clips and the plane is created between the capsule and the medial aspect of the pedicular vessels.

Our cancer control rates are reported in Table 1.

**COMPLICATIONS**
The perioperative complications rate in published reports ranges from 2.5 to 26%. The most common complications include hemorrhage, rectal injury, ureter injury, and stricture due to the anastomosis. The reported blood loss rate amongst robotic and laparoscopic prostatectomy case series is between 50-200 mL. Blood transfusion rates are 2% or less [10].

Intraoperative rectal injury occurs in 0.7% to 2.4% of cases. Ureteral injuries occur in less than 0.5% of all cases [11]. Anastomotic strictures following robotic prostatectomy in reported case series occur between 2.0% to 14.0% of cases.
This usually is correlated with surgical approach and surgeon experience [12].

OUTCOMES FOLLOWING ROBOTIC PROSTATECTOMY

Surgical margins

Surgical margins are a measure of cancer control during radical prostatectomy. Negative surgical margins indicate that the cancer has been removed during surgery. In a meta-analysis with data abstracted from 400 original research articles representing 167,184 Open Radical Prostatectomy (ORP) Patients, 57,303 Laparoscopic RP (LRP), and 62,389 Robotic Radical Prostatectomy (RALP) patients (total: 286,876), RALP was found at least equivalent to ORP or LRP with respect to surgical margin rates. The overall positive surgical margin (PSM) rates were 24.2% for ORP patients and 16.2% for RALP patients; pT2 PSM rates were 16.6% for ORP patients and 10.7% for RALP patients; pT3 PSM rates were 42.6% for ORP, 39.7% for LRP, and 37.2% for RALP [13].

We present results from case series for cohorts of greater than 700 patients (Table 1).

BIOCHEMICAL RECURRENCE

The American Urological Association defines biochemical recurrence as an initial serum PSA value equal to or higher than 0.2 ng/mL followed by a subsequent confirmatory level of PSA [14]. The European Association of Urology defines it as PSA values >0.2 ng/mL, confirmed by two consecutive measurements [15]. BCR is positively associated with the PSM, tumor stage and Gleason score. PSA elevations developed within the first 2 years following surgery are more often associated with distant metastatic disease. In a retrospective review of 357 open RP patients and 669 RALP patients who underwent surgery between 1999 and 2010 were compared for biochemical recurrence-free survival rates according to surgical approach, no differences were seen at 24 or 60 months postoperatively between open RP patients (87% and 71%, respectively) and RALP patients (87% and 73%, respectively) [16]. In a similar study,
evaluated 522 patients undergoing RALP with open RP patients; short-term follow-up yielded BCR rates of 93% for open and 94% for RALP [17].

**Urinary Continence**
Urinary incontinence after radical prostatectomy is often caused by damage to the urinary sphincter and alterations in the pelvic floor musculature. Less often, unstable detrusor muscle can lead to urgency incontinence; while post-operative anastomotic stricture and/or low-compliance bladder can induce overflow incontinence. Various surgical techniques such as 1) optimizing preservation of urethral rhabdosphincter length, without affecting the positive surgical margin rate [18]; 2) total reconstruction of the vesico-urethral junction [19]; 3) preservation of puboprostatic ligaments and arcus tendineus. Incising the puboprostatic ligaments just proximal to the prostate apex, and careful dissection in that plane is used so as to avoid detaching the urethral rhabdosphincter from its anterolateral ligamentous attachments [20]; 4) periurethral retropubic suspension stitch [21]; and 5) nerve sparing [22] are known to improve urinary continence outcomes.

**Sexual Functioning**
Postoperative potency rates ranging from 3.4% to 96.6% have been reported. These rates are largely dependent on the type of nerve sparing done and the surgical technique. For patients with postoperative erectile dysfunction, the choices of treatment include phosphodiesterase type 5 inhibitors (e.g. sildenafil, tadalafil, etc.), intraurethral or intracavernosal vasodilators, vacuum erection devices, and penile prosthesis.

**CONCLUSIONS**
Robotic radical prostatectomy has been shown to be a viable option for patients with clinically localized prostate cancer. Future studies with longer follow-up will address oncological outcomes such as disease-specific and overall mortality after robotic prostatectomy. In addition, questions regarding
the economics of RALP remain. In experienced hands, robotic assistance offers effective cancer control for prostate cancer patients. Furthermore, preliminary studies show that outcomes following RALP are promising. Finally, application of image-based diagnostic modalities such as MRI guided fusion biopsy, may better select patients suitable for robotic surgical treatment versus those best managed by other treatment modalities.

References: