

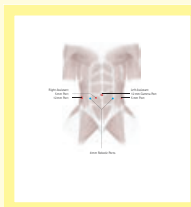
Surgery Illustrated

The Vattikuti Institute prostatectomy

Alok Shrivastava, Mithun Baliga and Mani Menon

Vattikuti Urology Institute, Henry Ford Health System, Detroit, MI, USA

Accepted for publication 2 March 2007



KEYWORDS

robotic, radical prostatectomy, prostate cancer, laparoscopy

INTRODUCTION

When laparoscopic radical prostatectomy (RP) was first described in 1992, its innovators were concerned that the procedure took too long and offered little advantage over conventional retropubic RP [1]. It was only after the pioneering work of Guillonnet and Vallancien [2], and Abbou *et al.* [3] that there was a resurgence of interest in the procedure. Nonetheless, many urologists feel that the procedure is exceedingly difficult to master and might offer little benefit to the patient [4].

Then the surgical robot was developed; with stereoscopic vision, wristed instruments and scaled intuitive movements, this device allows open surgeons trained in retropubic RP to change to using minimally invasive surgery for prostate cancer, without undergoing arduous laparoscopic training.

We established a structured programme for robot-assisted RP, using the daVinci surgical system (Intuitive Surgical Inc., Sunnyvale, CA, USA) in 2001 [5]. Due to the ease of learning and improved functional outcomes, this procedure is increasingly accepted by patients and their urologists across the USA. It is estimated that up to half of patients undergoing RP in 2006 will choose the robotic approach.

In this article we present our current technique of robotic RP, which we term the Vattikuti Institute prostatectomy (VIP). We think that this technique minimizes morbidity and maximises functional outcomes, while maintaining the excellent oncological outcomes achieved by traditional surgery.

PLANNING AND PREPARATION

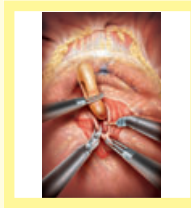
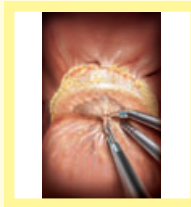
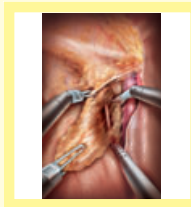
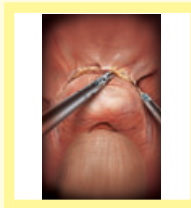
The indications for VIP are identical to those for open RP, i.e. patients who have localized prostate cancer with biologically significant disease and a life-expectancy of >10 years.

We recommend surgery to all patients who have other than focal Gleason ≥ 6 cancer and a Charlson comorbidity score of <3. Patients with Gleason <6 and <10% cancer in a single core are advised to have a saturation prostate biopsy with 24-core sampling. If there is no change in the Gleason score or the volume of the prostate cancer on saturation biopsy the patient is offered continued monitoring with follow-up biopsies.

The decision about the type of nerve-sparing procedure depends on the Gleason grade and the volume of the tumour on biopsy. Patients with >25% cancer and Gleason ≥ 7 disease have conventional nerve-sparing on the ipsilateral side; all others have an extended nerve preservation procedure, with preservation of the lateral prostatic fascia, a technique we described as the 'veil of Aphrodite' [6].

SPECIFIC PATIENT PREPARATION

In preoperative counselling, the VIP procedure and other treatment options are discussed



with the patient. A brief review of our published results and those of others is discussed. Patients are encouraged to go to our and other prostate cancer-related web sites for their 'due diligence'.

A wait of ≥ 6 weeks after prostatic biopsy before surgery is advised; this allows for the resolution of periprostatic inflammation and haematoma caused by the biopsy. Discontinuation of aspirin and antiplatelet agents is required for ≥ 2 weeks before surgery, because even slight bleeding obscures vision and makes the dissection imprecise.

The evaluation before surgery includes a complete blood count, coagulation profile and bowel cleansing. A chest X-ray and electrocardiogram are also obtained. In patients with a significant cardiac history, preoperative cardiac clearance is obtained. Anticoagulation, if any, is stopped 1–2 weeks before surgery, in consultation with the ordering physician.

Patients take a clear liquid diet and use a laxative 1 day before surgery; antibiotic prophylaxis is given before surgery as per the hospital protocol. A combination of compression stockings and s.c. heparin

(5000 units) is used before and after surgery during the hospital stay.

All patients have VIP under general anaesthesia with endotracheal intubation and muscle relaxation. It is suggested to restrict i.v. fluids to 600–800 mL until the anastomosis is completed. This avoids excessive production of urine during surgery, therefore needing fewer suction manoeuvres to clear the field.

SPECIFIC EQUIPMENT/MATERIALS

Figure 1 The operating room system: the da Vinci surgical system is a sophisticated master-slave device. It has a surgical cart with three or four multi-jointed arms, one controlling a binocular endoscope and the others controlling articulated instruments inside the patient's body. This is the 'slave' component of the system, which is controlled by the surgeon's console. The surgeon console has two master arms. The surgeon moves the masters, and these movements are translated in real time into movements of the instrument tips inside the patient's body. The master arms can be made to control camera movements by pressing a foot pedal. The surgeon has a stereoscopic or three-dimensional (3D) display of the operating field. We also have a custom-built 3D display system for the assistants.

THE SURGICAL TEAM

The VIP team includes one console-side and two patient-side surgeons, and a scrub nurse. The operating surgeon sits at the console and is not scrubbed. The patient-side team is scrubbed and uses laparoscopic instruments to present the operative field to the operating surgeon.

INSTRUMENTS

The familiarity of the surgical team with the robotic instruments and consumables facilitates a quick change of instruments and faster troubleshooting. 'Dry laboratory' experience for the surgical team to practice on the robotic instruments is strongly recommended. The robotic instruments have been continuously developed; the following is a list of instruments currently used by our team.

- Ports: two robotic 8 mm, four laparoscopic ports with dilating-tip trocars (12 and 5 mm two each, two 12 mm to 5 mm port-reducer caps).
- Instrument used for the robotic arms: 0 and 30° binocular telescope; sterile arm drapes; sterile adapters for the instrument arms; Endowrist monopolar hook cautery, bipolar graspers, round-tip scissors and two needle drivers. Recently, we have used 5-mm robotic instruments. The procedure can be performed with just three instruments, i.e. a Maryland grasper, monopolar hook and a needle driver, significantly reducing the consumable costs.

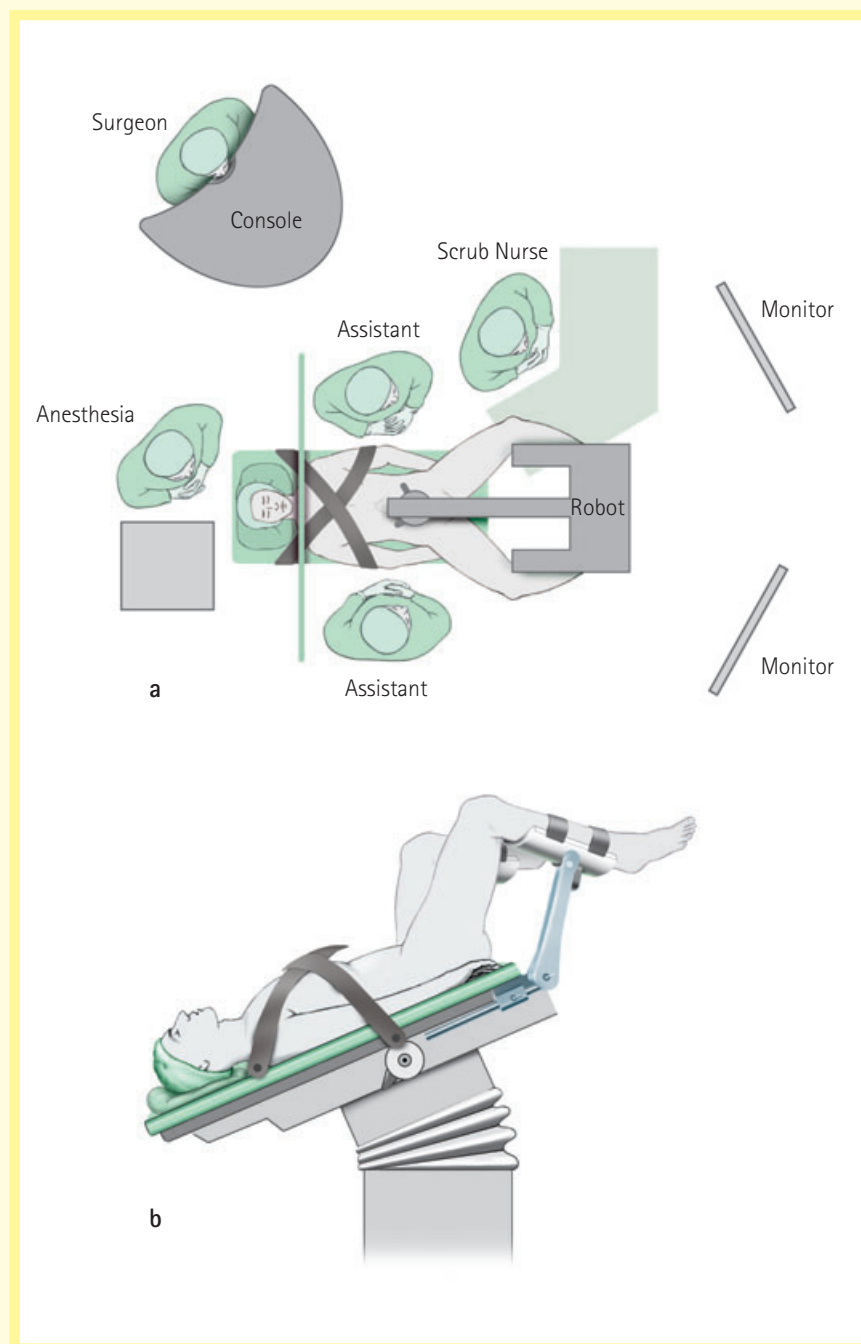
- Instruments used by patient-side assistants: Veress needle; laparoscopic graspers; suction irrigator with long suction cannula; laparoscopic scissors; laparoscopic needle drivers; specimen retrieval bag; and laparoscopic clip appliers.
- Sutures: 0- polyglactin 910 suture on a CT-1 (36-mm, taper) needle; 2-0 polyglactin 910 suture on an RB-1 (17-mm taper) needle; two 3-0 poliglecaprone 25 sutures on RB-1 (17-mm taper) needles, one dyed and one undyed; 0 braided polyester suture on CT-1 (36-mm,

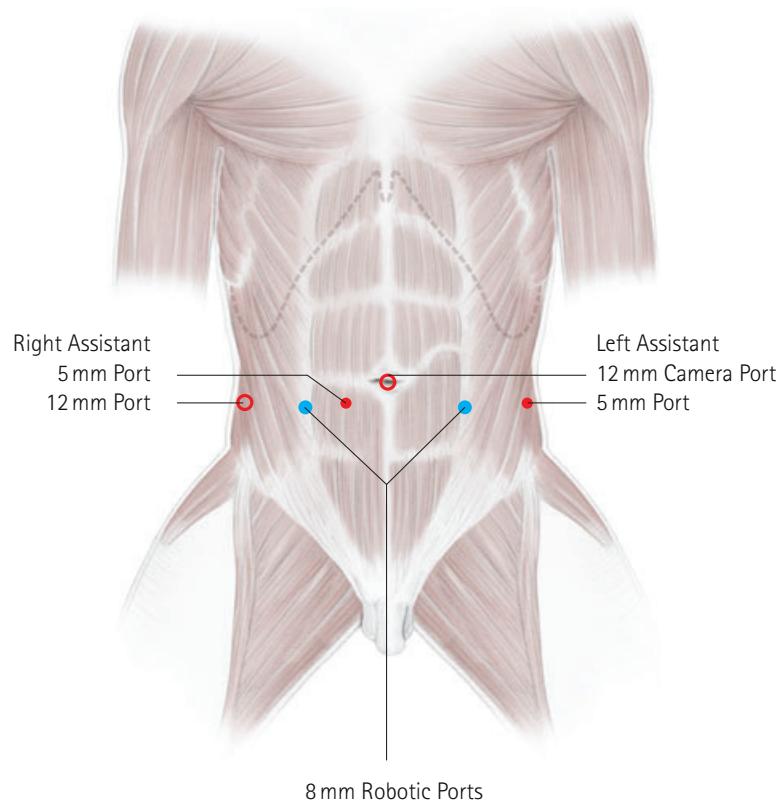
taper) needle; and 4-0 poliglecaprone 25 suture on PS2 (19-mm reverse-cut) needle.

- Also, a high-flow pneumo-insufflator and an electrocautery machine are needed.

SPECIFIC PATIENT POSITIONING

Figure 1(b). The patient is placed in the lithotomy position with the legs separated in flexion. The leg separation in this position helps in placing the surgical cart between the legs. Both arms are padded and taped by the





sides. Padded cross-strapping of the patient's chest is done to the operating table to prevent any movement, as the table is set in an extreme Trendelenburg position after placing the ports. After the patient is prepared and draped, a Foley catheter is placed into the bladder and an orogastric tube placed.

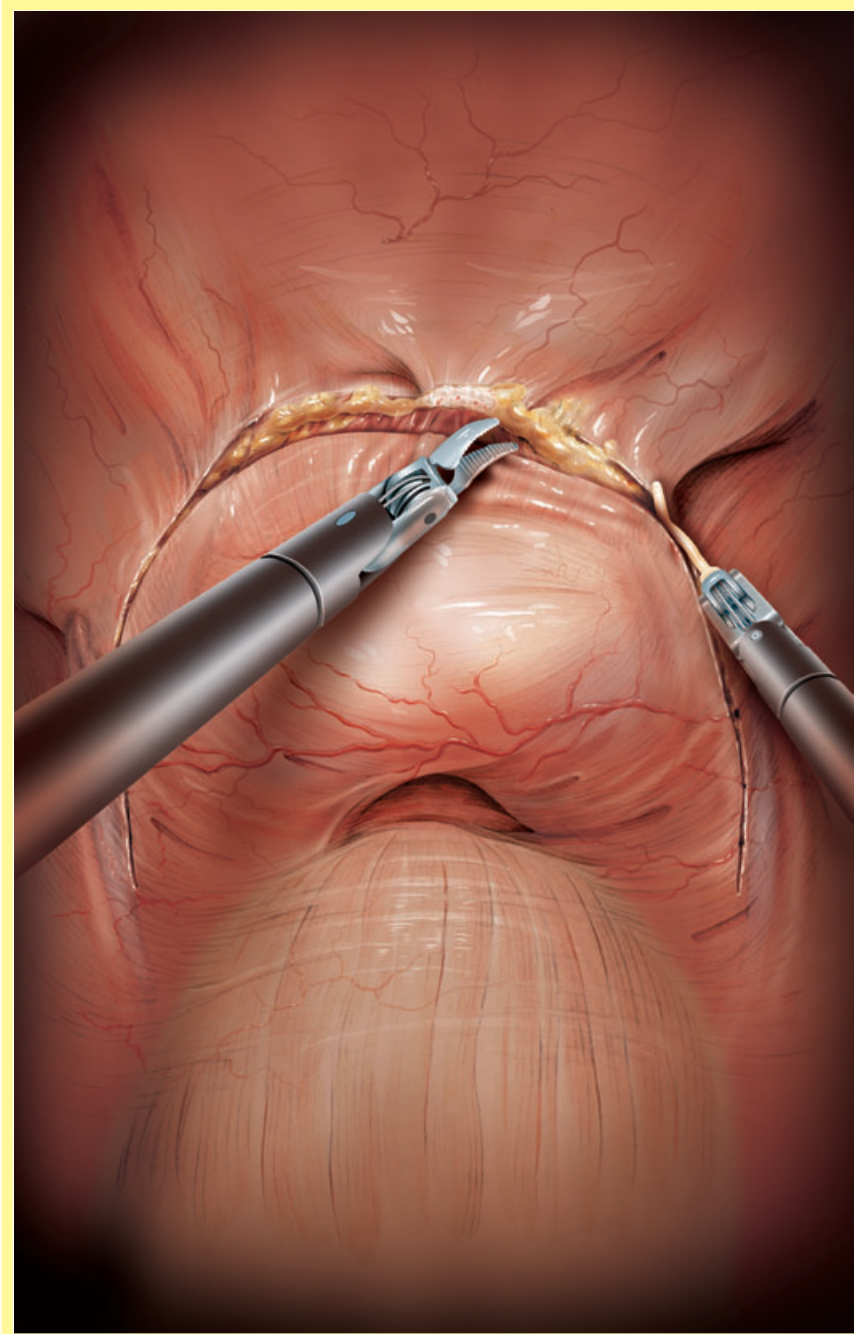
SURGICAL STEPS

FIGURE 2. STEP 1; PORT PLACEMENT

Pneumoperitoneum of 20 mmHg is created by placing a Veress needle through an incision just lateral to the umbilicus. A 12-mm camera port is placed blindly through the same incision; a 30° binocular telescope, looking upward, is then placed through the camera port. All other ports are placed under direct vision as shown in Fig. 2. After placing the ports the pneumoperitoneum pressure is decreased to 15 mmHg. The surgical cart is then docked to the ports.

FIGURE 3 STEP 2; ENTRY INTO THE SPACE OF RETZIUS

The extraperitoneal space is entered through an inverted, U-shaped incision on the parietal peritoneum, superior to the dome of the bladder and lateral to the medial umbilical ligaments. The vertical limb of the peritoneal incision is made lateral to the medial umbilical ligament, and medial to the internal inguinal ring. The vas deferens is seen coursing obliquely across the incision and can be retracted from the operating field or divided before further dissection. When the inferior portion of the vertical limb of the peritoneal incision is deepened, the pubic bone is seen as an anatomical landmark and the iliac vessels lie laterally. The incisions are joined anteriorly, dividing the bilateral medial umbilical ligaments and urachus, and then the bladder is dissected off the anterior abdominal wall to enter into the space of Retzius. Avoiding the entry into the 'cul-de-sac' is a significant departure from the 'Montsouris' technique of laparoscopic RP [2]. A surgeon trained in open retropubic RP finds this dissection more familiar.



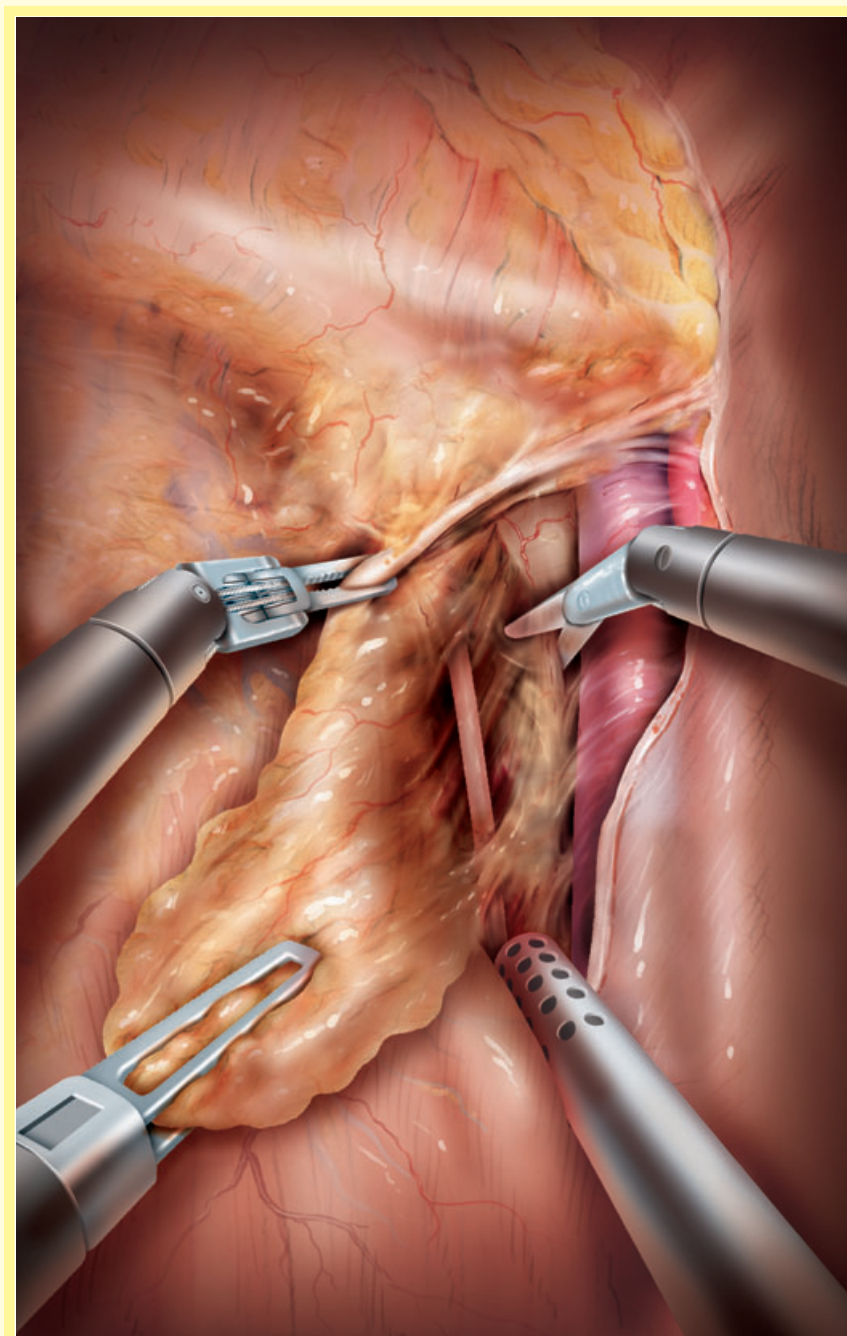
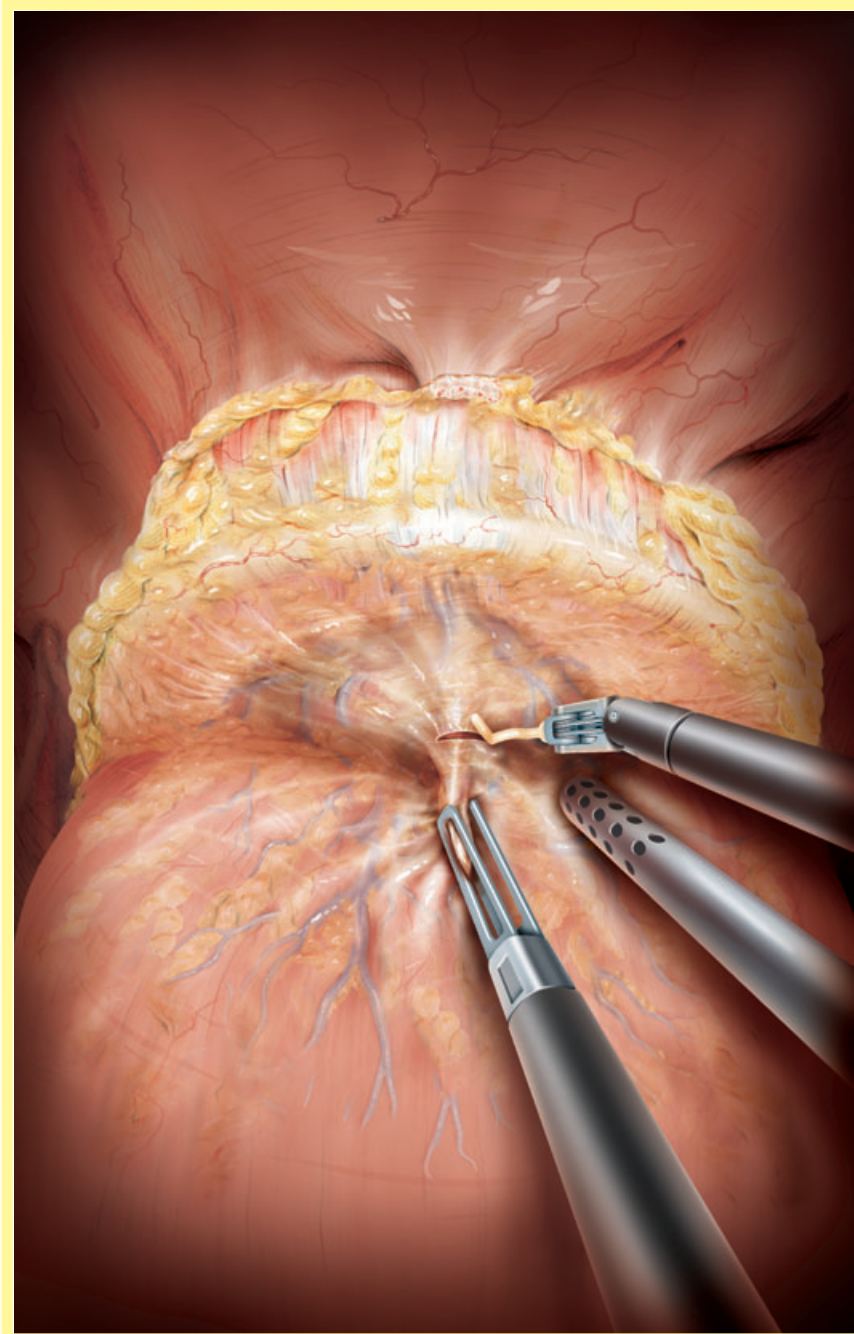


FIGURE 4 STEP 3; BILATERAL PELVIC LYMPHADENECTOMY

The retroperitoneal fat is cleared from the anterior surface of the external iliac vein; the latter is identified and dissected carefully along its inferior border. The obturator nerve is identified and serves as the posterior margin of dissection. Beginning at the pubic ramus, the lymph nodes and fatty tissues are cleaned from the obturator fossa. The packet of fibro-fatty and nodal tissue is grasped by the contralateral assistant and dissected toward the bifurcation of the external iliac vein.

FIGURE 5 STEP 4; BLADDER NECK DISSECTION

Anterior bladder neck: this portion of the procedure is best done with a 30° lens looking down. The right-hand assistant grasps the anterior bladder wall in the midline with an atraumatic grasper, lifts it directly towards the ceiling and the left assistant deflates the Foley balloon while keeping the catheter in the bladder. This simple manoeuvre aids in identifying the bladder neck, as the bladder pulls away from the prostate except at the midline anterior to the catheter. A 1 cm incision is made in the anterior bladder neck at the 12 o'clock position, cutting down the detrusor to expose the catheter in the midline. Most of the dissection in this approach is done before controlling the dorsal venous complex. This is a translation of our open approach into the robotic procedure. This approach also helps us to make a precise apical dissection with no distortion of the anatomy by a dorsal venous suture. This helps to prevent positive surgical margins at the prostatic apex. The bleeding from the sinuses is not an issue, as it can be easily controlled by maintaining the pneumoperitoneal pressure.



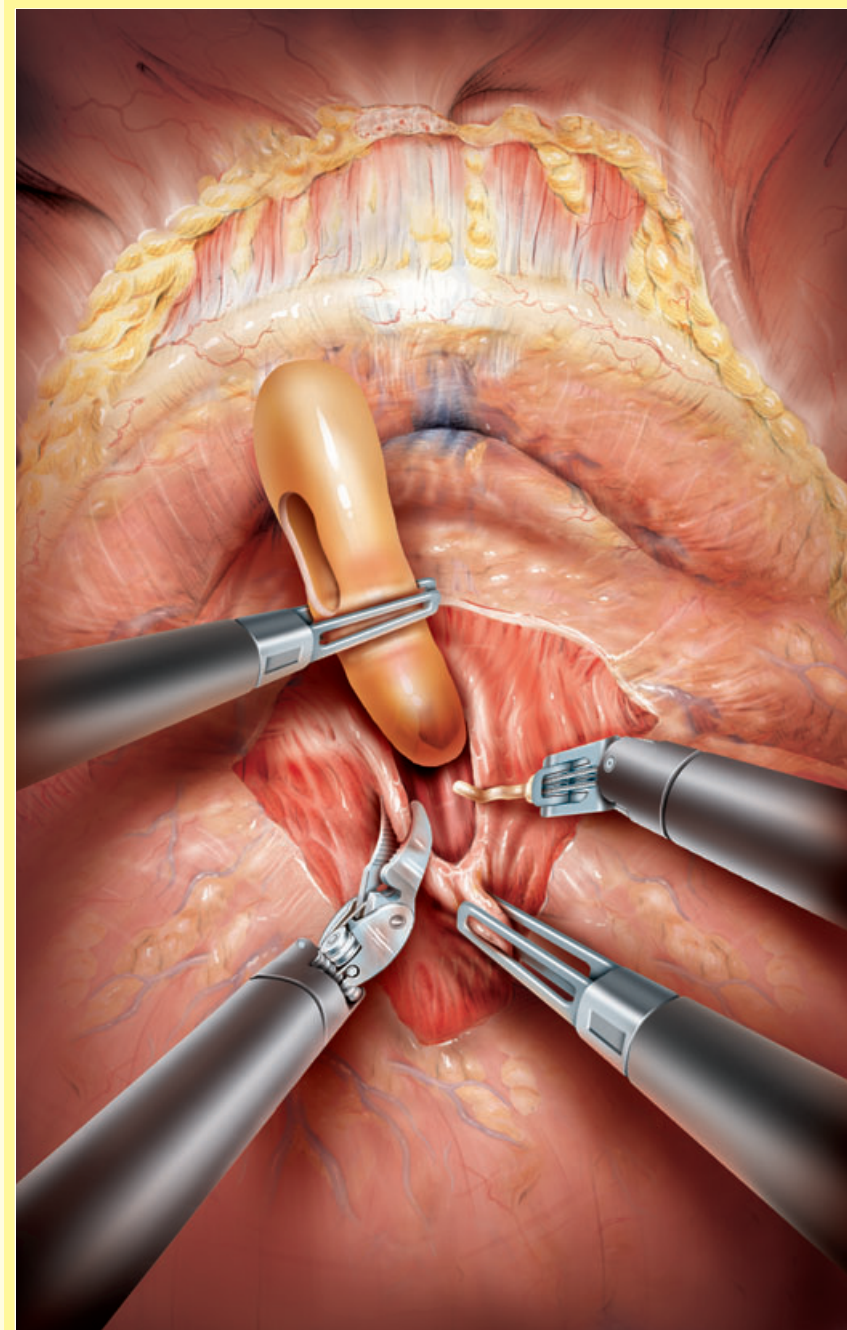
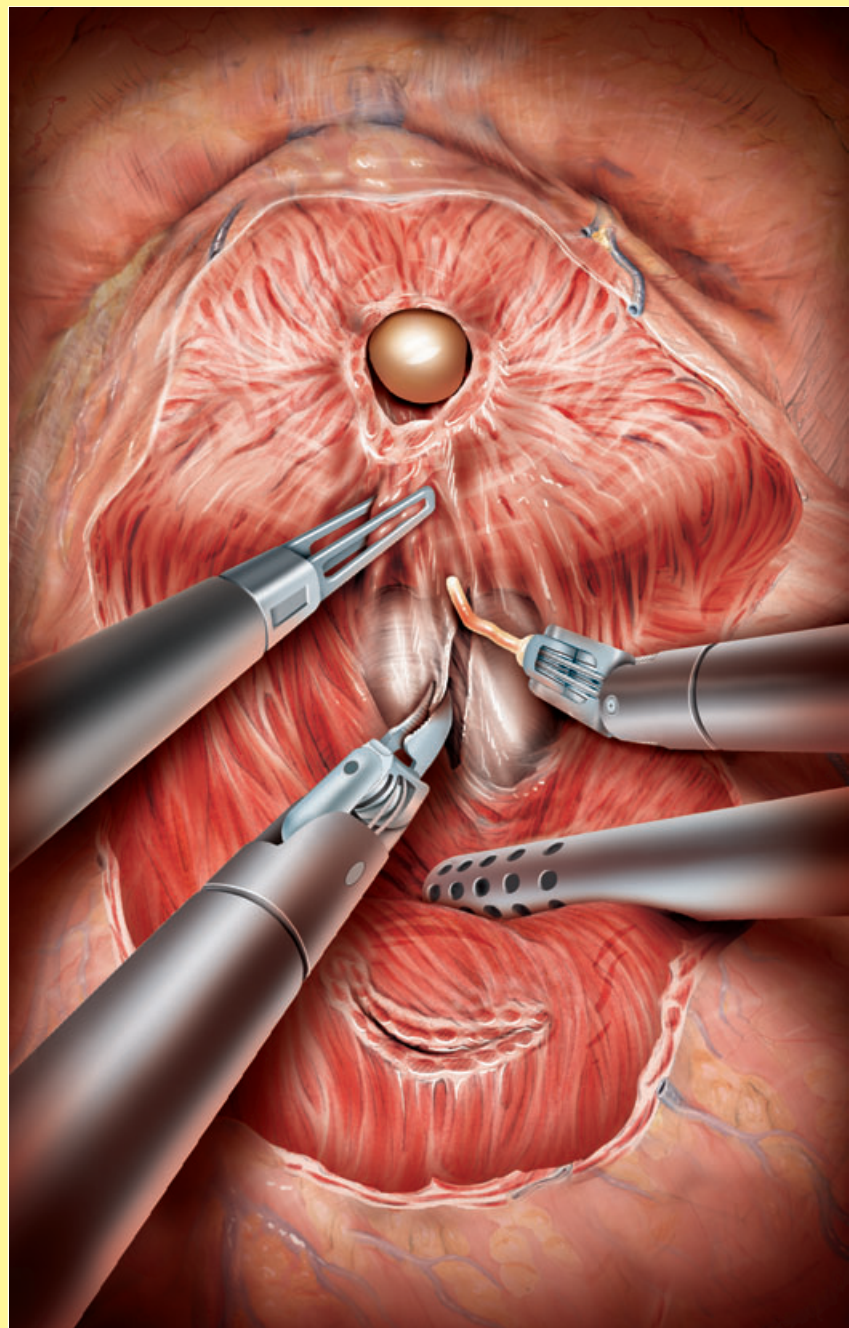


FIGURE 6 POSTERIOR BLADDER NECK

After the anterior bladder neck is incised, the left-side assistant grasps the tip of the Foley catheter with firm anterior traction. This exposes the posterior bladder neck, which is incised. The posterior bladder neck is gradually dissected away from the prostate. The direction of the dissection is directly posterior; care should be exercised to avoid dissecting into the prostate or in the posterior detrusor wall.

FIGURE 7 STEP 5; POSTERIOR DISSECTION

Incising the anterior Denonvilliers fascia: after the full thickness of detrusor at the posterior bladder neck is divided, the left-side assistant provides upward traction to the posterior base of the prostate. This exposes the anterior layer of Denonvilliers' fascia, covering both vasa deferentia and seminal vesicles. This fascia is incised to create a window from where the vasa deferentia and seminal vesicles can be pulled anteriorly and dissected.



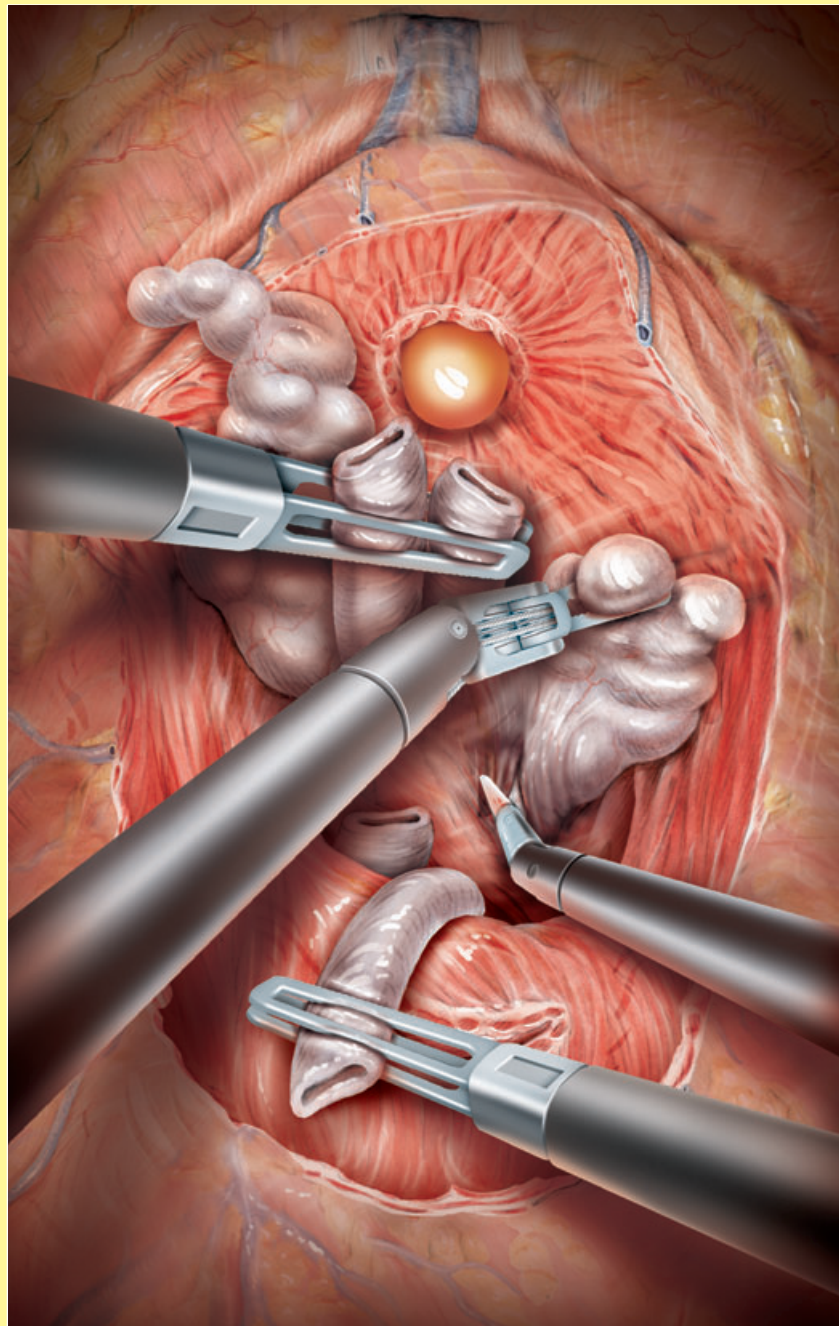
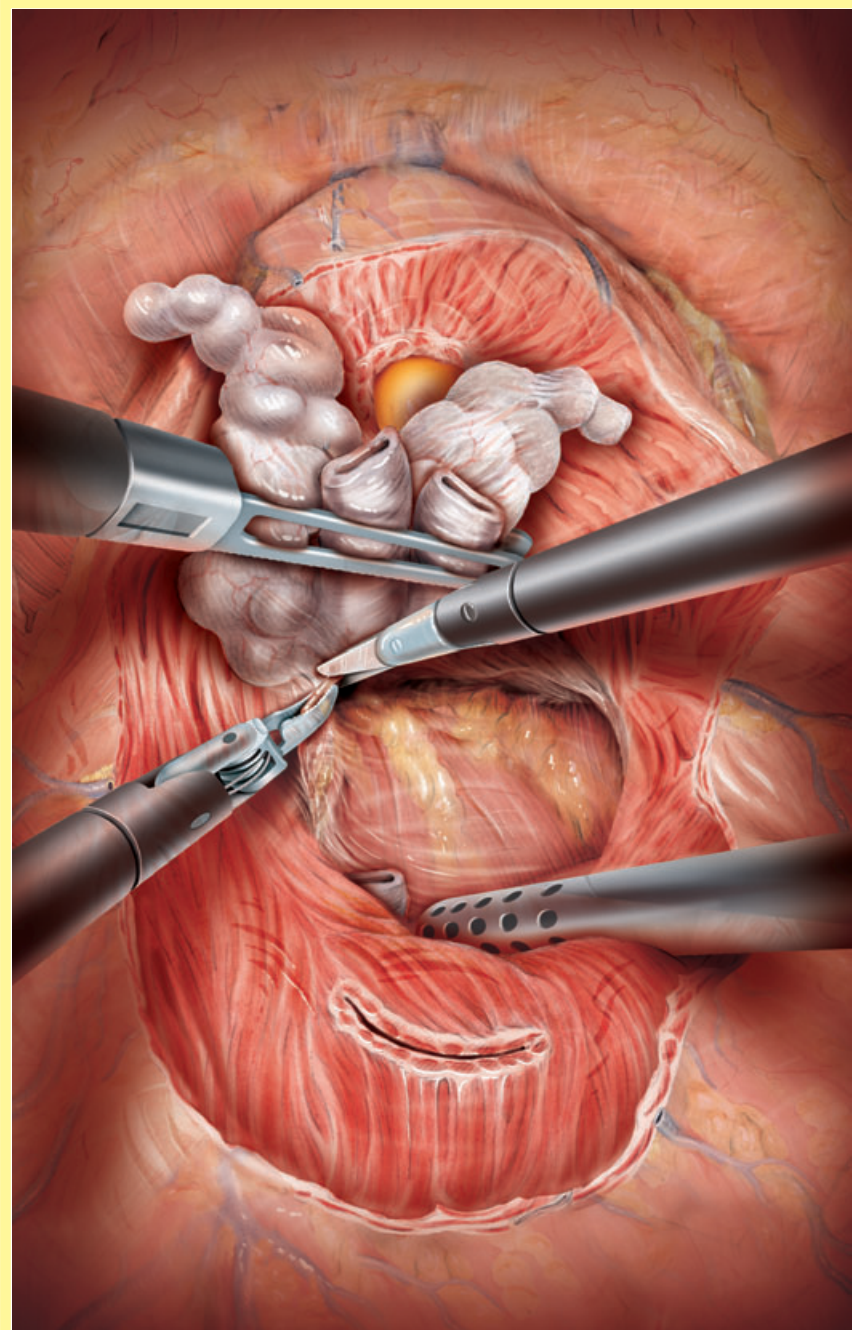


FIGURE 8 VAS DEFERENS AND SEMINAL VESICLE DISSECTION

The vas deferens are skeletonized and then cut. The left-side assistant grasps the distal stumps of the vasa and lifts upward while the right-side assistant retracts their proximal ends in the opposite direction. This exposes the seminal vesicles, which are then dissected using blunt and sharp dissection. The blood vessels supplying the seminal vesicles are controlled by titanium clips or fine bipolar coagulation.

FIGURE 9 POSTERIOR DENONVILLIERS' FASCIA INCISION

Both the vasa and seminal vesicles are then grasped by the left-side assistant and the posterior prostate is retracted upwards, allowing exposure of the posterior layer of Denonvilliers' fascia. An incision is made in this fascia and a plane is developed between the posterior layer of Denonvilliers' fascia and perirectal fat. This is an avascular plane and it can be created easily by blunt dissection. The dissection is carried down to the apex of the prostate. This plane of dissection is extended laterally to expose the lateral pedicles of the prostate.



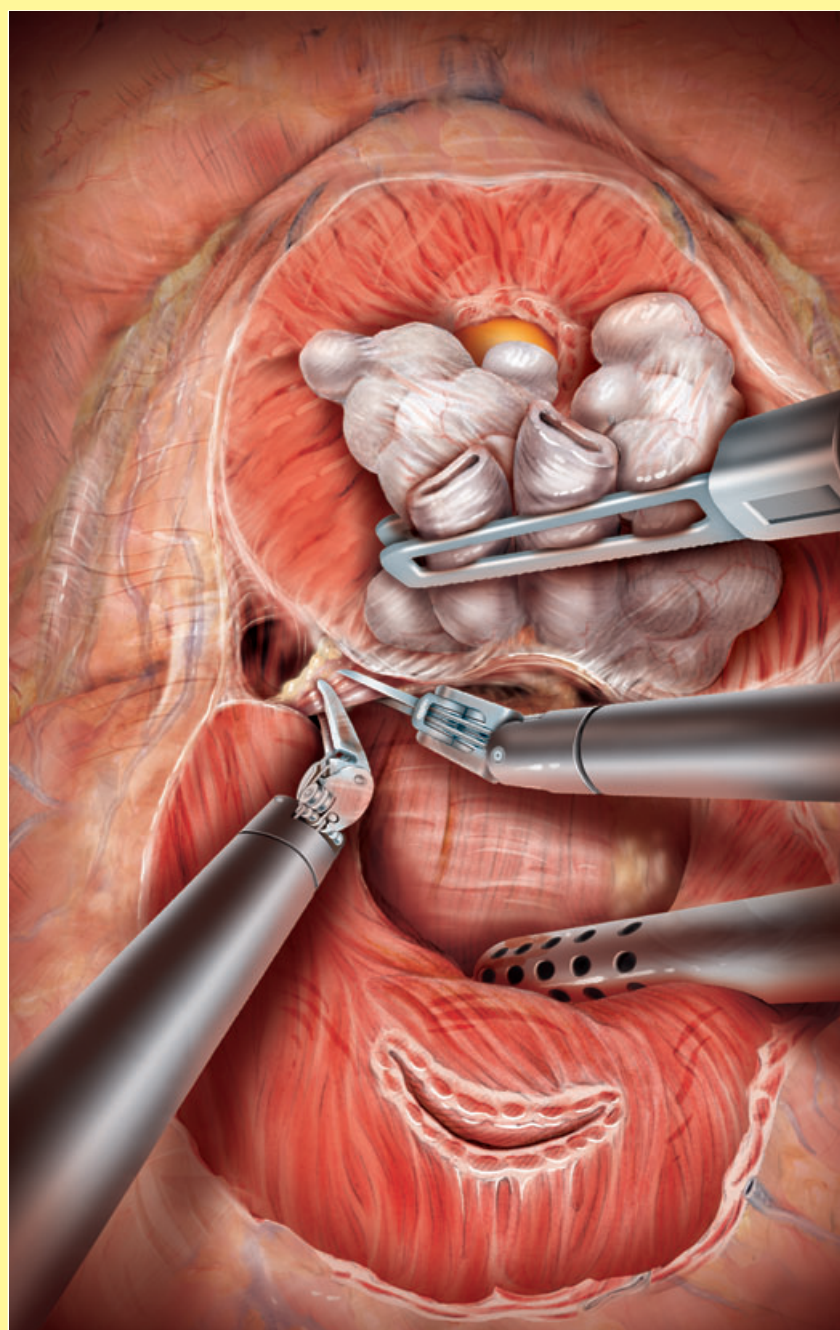


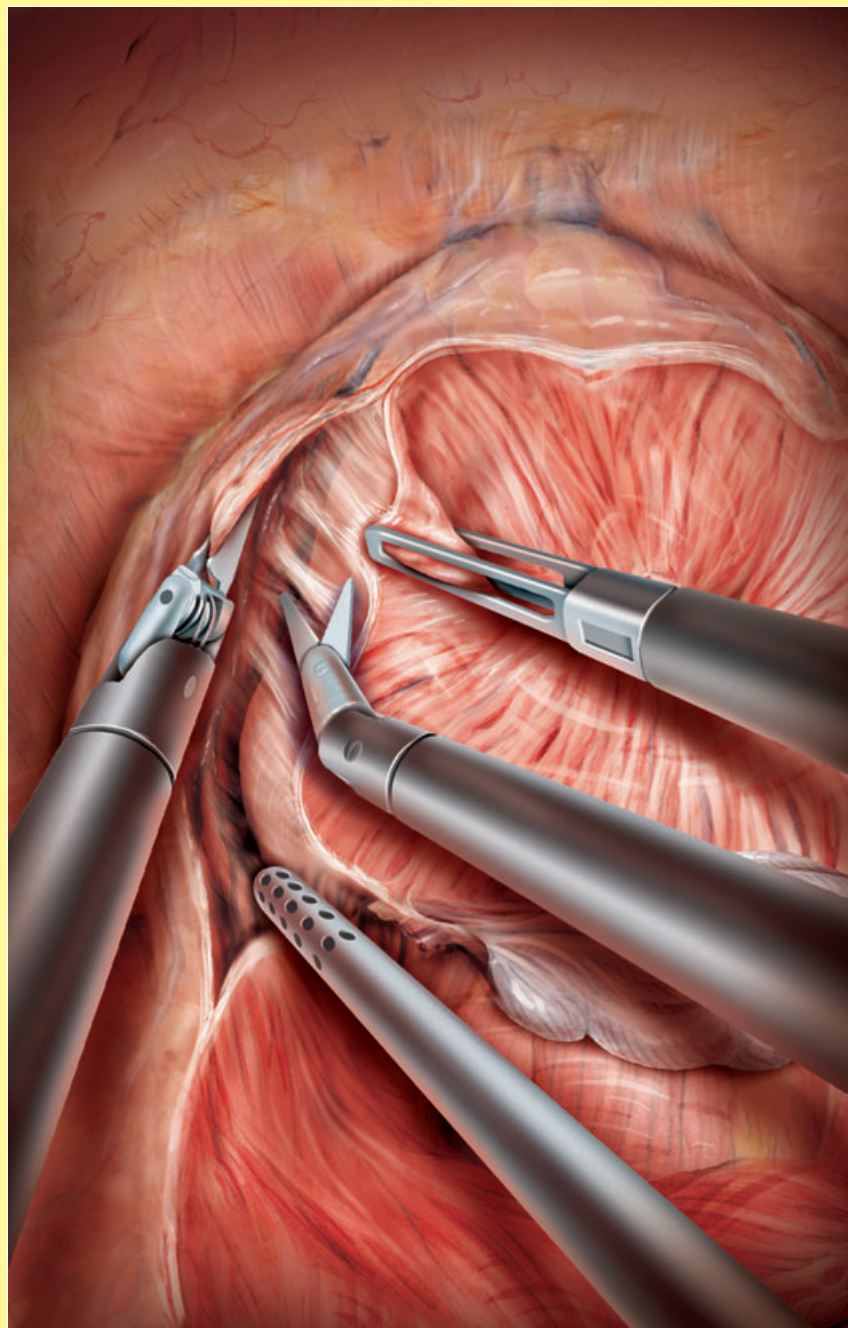
FIGURE 10 STEP 6; CONTROL OF THE PEDICLE AND NERVE-SPARING

The base of the seminal vesicle is retracted superomedially by the assistant on the opposite side, and the prostatic pedicle is delineated and divided. This pedicle lies anterior to the pelvic plexus and neurovascular bundle, and includes only a prostatic blood supply. The pedicles are controlled by either clipping or individually coagulating the vessels by bipolar cauterization.

Standard nerve-sparing: The prostatic fascia anterior and parallel to the neurovascular bundles is incised. The neurovascular tissue is then dissected off the prostate posterolaterally. The assistants retract the prostate in the direction of the contralateral shoulder of the patient, to provide exposure. After the correct plane is entered, most dissection occurs in a relatively avascular plane. The dissection is then carried distally beyond the prostatic apex to expose the urethra posterolaterally.

FIGURE 11 VEIL OF APHRODITE: PRESERVING THE LATERAL PROSTATIC FASCIA

There is growing evidence that rather than distinct posterolateral neurovascular bundles, lattices of nerves are located on the anterolateral surfaces of the prostate within the prostatic fascial layers. In the Veil procedure we preserve this neurovascular complex supported by the lateral prostatic fascia. A plane between the prostatic capsule and the inner periprostatic fascial layer is developed at its cranial extent. The assistants provide superomedial prostatic retraction and lateral retraction on the tissues adjacent to the neurovascular bundle. This allows the surgeon to enter a plane between the prostatic fascia and the prostate. This plane is deep to the venous sinuses of Santorini's plexus. Careful sharp and blunt dissection of the neurovascular bundle and contiguous lateral periprostatic fascia is done until the entire periprostatic fascia up to and including the ipsilateral pubo-urethral ligament is mobilized in continuity off the lateral aspect of the prostatic apex.



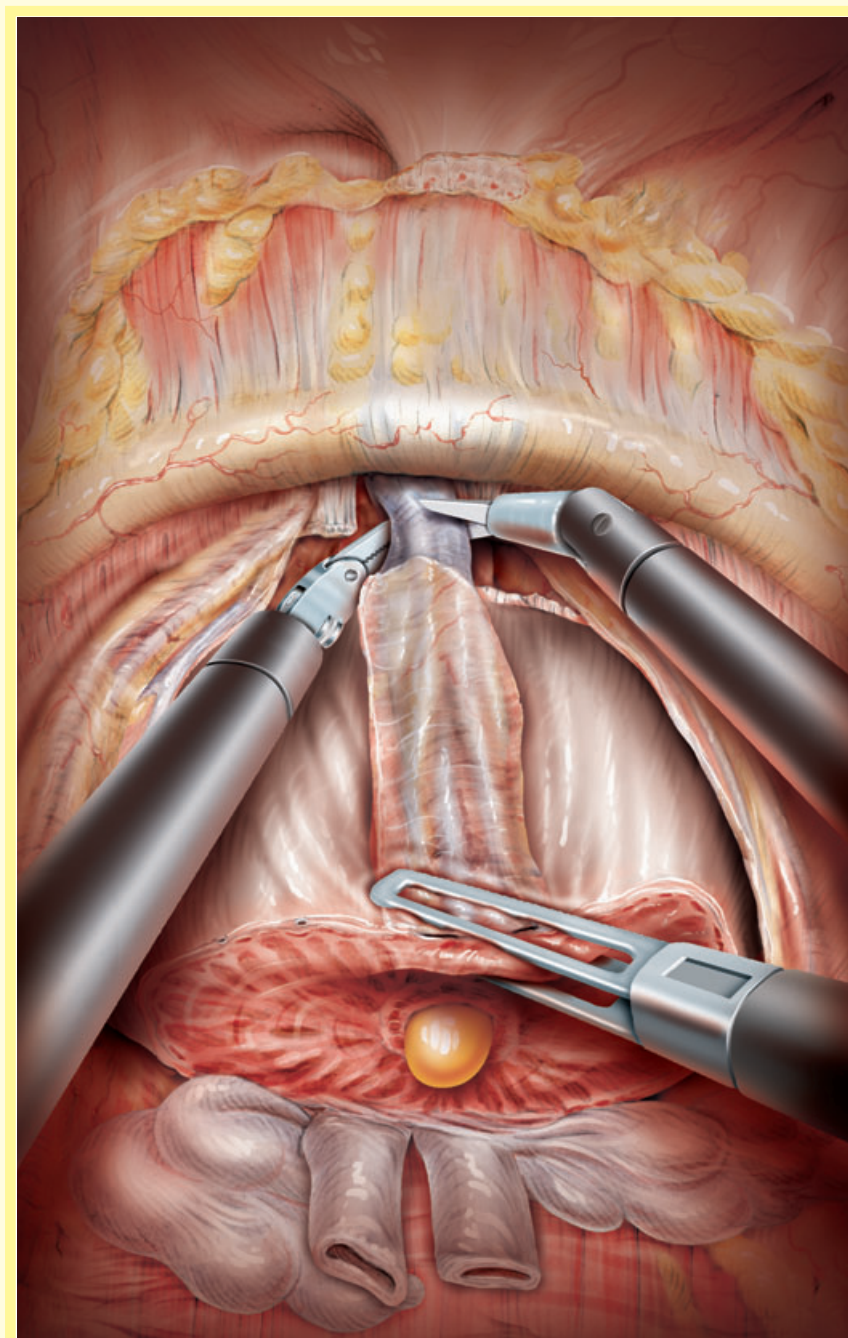


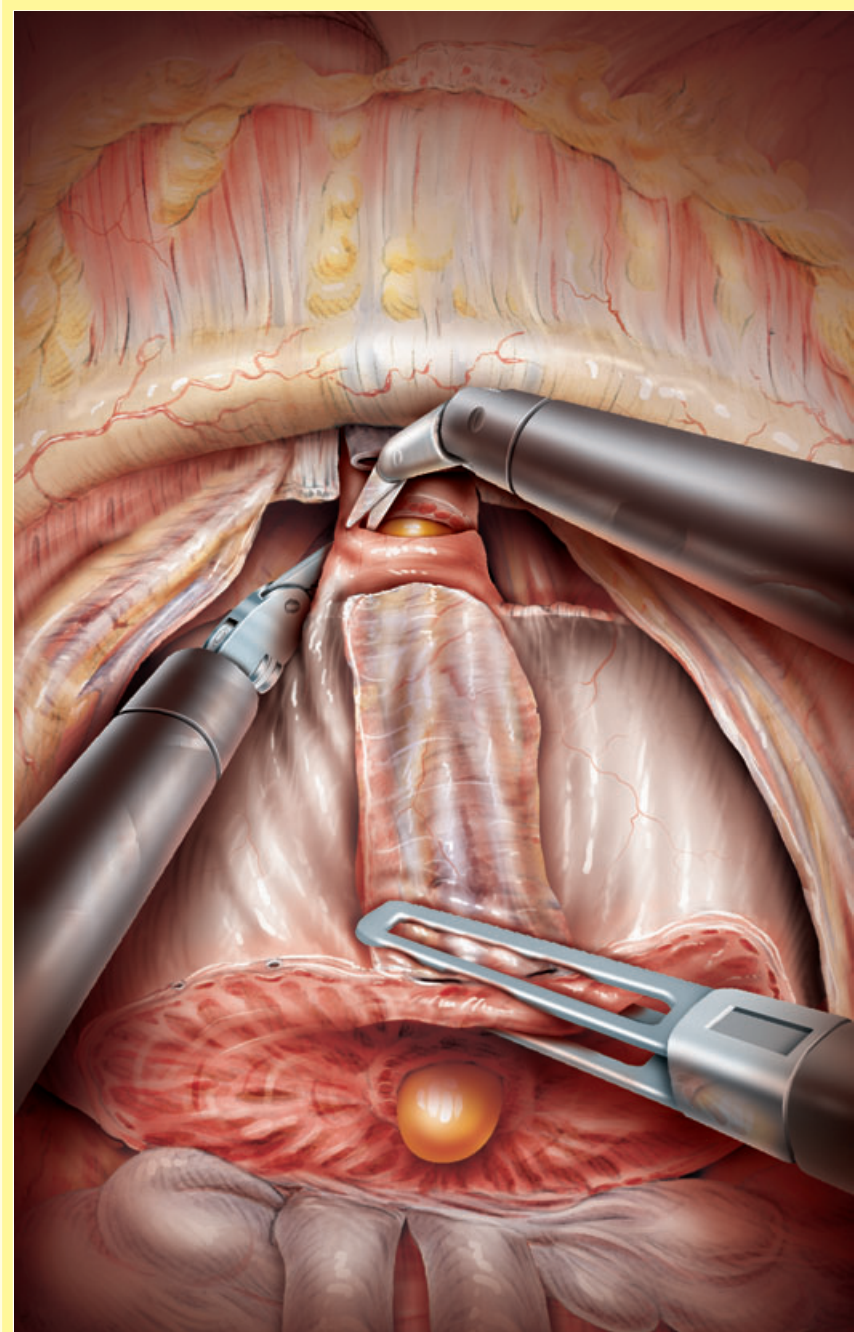
FIGURE 12 STEP 7; APICAL DISSECTION AND CONTROL OF DORSAL VENOUS COMPLEX

For the incision of the puboprostatic ligaments and dorsal vein complex, the binocular telescope is changed to a 0° lens. The right assistant retracts the prostate firmly to the patient's head. Periprostatic tissues are incised sharply and cleanly with the robotic scissors. The puboprostatic ligament is incised where it inserts into the apical prostatic notch. The dorsal veins are also divided at the same level. Due to pneumoperitoneum the opened venous sinuses do not bleed.

FIGURE 13 URETHRAL TRANSECTION

The urethra is then dissected into the prostatic notch. It is important not to skeletonize the urethra; maintaining the fibrovascular support of the urethra intact hastens the return of continence. To avoid positive surgical margins the urethra is transected sharply 5 mm distal to the notch. The anterior wall is cut with the Foley catheter across the urethra. The Foley is then withdrawn and the bipolar grasper is passed behind the posterior urethral wall to separate the urethral wall from recto-urethralis and the rectal wall. This step is important to prevent injury to the rectum when the remainder of the urethra is cut sharply with robotic scissors. The prostate specimen is now free and it is placed in a specimen-retrieval bag for later retrieval.

The dorsal venous complex is then controlled by a suture of 2/0 polyglactin. Haemostasis of the prostatic bed is achieved by clips or by fine bipolar coagulation.



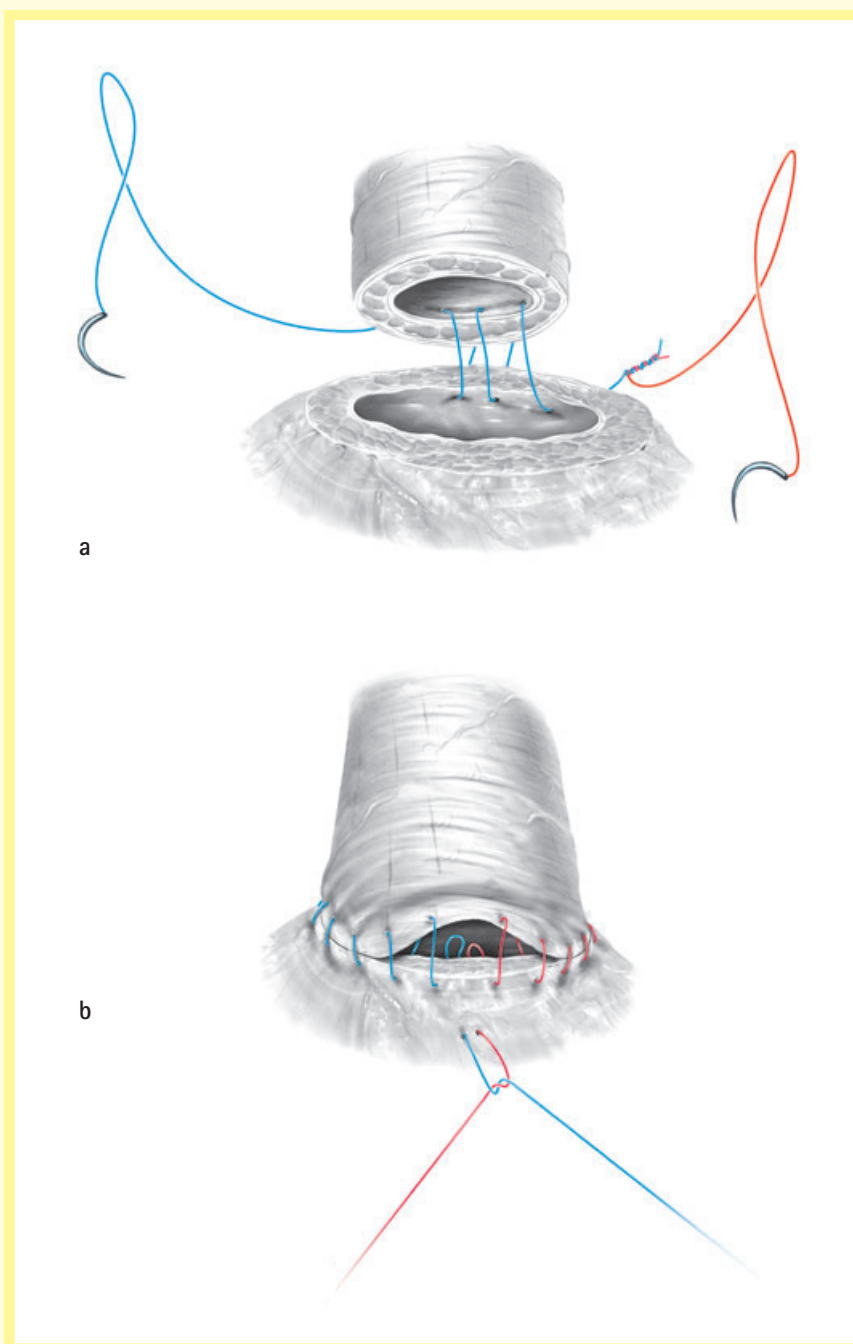


FIGURE 14 STEP 8; ANASTOMOSIS

The technique that we use is a slight modification of that described by van Velthoven *et al.* [7]. The suture for anastomosis is prepared by tying two 3-0 poliglecaprone sutures on an RB 1 needle, 18 cm long, back-to-back. One suture is dyed and another is undyed. The suture is now a double-armed suture with a pledget of knots.

The suture is started with the violet-dyed arm, on the posterior bladder wall at the 4 o'clock position, outside-in. The urethral bite is made inside-out, at the corresponding site. After three such bites, which cover a major portion of the posterior aspect of the anastomosis, the bladder is brought down by tightening the suture. Tightening the suture in this way reduces the risk of sutures cutting through the urethral stump.

A Connel suture is then taken at the bladder, thereby changing the direction of the passage of the needle from outside-in at the bladder to inside-out and inside-out at the urethra to outside-in. The suture is run clockwise up to the 11 o'clock position; at this point the suture can be locked and the suture is then held by the left-side assistant, under gentle traction.

The other undyed arm is then run counter-clockwise from the 4 o'clock to the 11 o'clock position. While placing the anastomotic sutures the left-side assistant moves the tip of urethral Foley in an out of the urethral stump to prevent suturing of the back wall of the urethra. Both arms of the suture are tied to each other to complete the anastomosis. A new 20 F Foley catheter is introduced and its balloon is inflated to 20–30 mL. The bladder is filled with 250 mL of saline to test the integrity of the anastomosis.

STEP 9; SPECIMEN RETRIEVAL AND CLOSURE

A Jackson-Pratt drain is placed through the left 5-mm port and is secured to the skin with a #30 Nylon suture. The specimen within the retrieval bag is removed after enlarging the umbilical port incision as required. The fascia of the incision is then closed with two interrupted sutures of 0 braided polyester. The skin is closed by 4-0 braided polyglactin, subcuticular sutures and sterile strips.

POSTOPERATIVE CARE

Patients are admitted to a short-stay unit, from where they are discharged after 23 h. Overnight they receive i.v. fluids, non-opiate analgesics, prophylaxis for deep vein thrombosis with s.c. heparin, and antibiotic prophylaxis according to the hospital protocol. They start ambulation on the evening of surgery and stay on a clear liquid diet until advanced to a regular diet after the first bowel movement.

The Jackson-Pratt drain is removed on the first day after surgery; the urethral catheter is removed at 4–10 days, after no urinary leak is detected on a cystogram.

FROM SURGEON TO SURGEON: THE DIFFICULT CASES

A history of ruptured viscera, peritonitis or extensive abdominal surgery deserves special mention. These patients might have extensive peritoneal adhesions requiring difficult adhesiolysis before placing the ports. The operation is more difficult in patients who are markedly obese (body mass index $>40 \text{ kg/m}^2$), in those who have had radiation or androgen-deprivation therapy, and in those with a history of transurethral or suprapubic prostatectomy. Large prostates ($>100 \text{ g}$), large median or lateral lobes, or an android (narrow) pelvis can lead to a difficult dissection. We advise caution in accepting patients with these factors during the early experience of the surgical team.

THINGS TO MAKE LIFE EASIER

A structured programme for training assistants and a consistent surgical team are the most important factors in making an efficient robotic RP team. We find stereoscopic displays for the assistants to be a very useful tool in improving their performance.

The use of appropriate lenses, as described above, i.e. 0° , 30° up and 30° down, in various steps of the procedure helps to visualize the operative field, while avoiding clashing of instruments and telescope in the narrow pelvic space.

LOWS: THE WORST CASE

We operated on a 62-year-old man with a Gleason 6 adenocarcinoma of the prostate.

We thought we had done quite well, because the operative time was $\approx 60 \text{ min}$ and the blood loss was $<100 \text{ mL}$. The patient was fine overnight, but appeared pale and clammy the next morning. His haemoglobin level decreased to 10 g/dL and his abdomen became distended. A diagnostic laparoscopy, as an emergency, showed a few clots in the pelvis, as might be expected after RP, but there was no apparent active bleeding. The patient was observed in the operating room, but continued to develop abdominal distension and became hypotensive. In an emergency laparotomy the pelvis was full of clots, with brisk arterial bleeding. As we were not sure where the blood was coming from, the aorta was cross-clamped. Ultimately, the bleeding was from an accessory obturator artery that had been partly transected. One titanium clip was all that was required to control the bleeding. After a rather eventful course, complicated by operative colicystitis, the patient recovered well. His PSA level was undetectable, his urinary control excellent but he has erectile dysfunction.

This case had gone so well initially that we had videotaped it; a thorough review of the videotape revealed an intact and pulsatile accessory obturator artery at the end of the anastomosis. The video recording ended with the anastomosis. We surmise that the obturator artery might have been damaged while the RB1 suture, used for the visceral urethral anastomosis, was removed by the assistant. Because the transection was partial and tangential, the artery was unable to retract, and hence caused the bleeding.

HIGHS: THE SINGLE MOST HELPFUL ASPECT

A firm founding in surgical anatomy, experience in open surgery and mentoring in laparoscopic surgery were the three factors that helped our structured programme to succeed. Approaching the bladder neck first and using the van Velthoven suture for a continuous anastomosis of the urethrovesical junction have also made the procedure easier.

SUPPORT STRATEGIES FOR PROBLEMS DURING SURGERY

If venous bleeding is encountered, temporarily increasing the pneumoperitoneum pressure to

20 mmHg controls the bleeding and keeps the operative field clean. In some patients, a narrow pelvic brim can restrict the movements of the robotic instruments in the prostatic apical region. The assistants should move the robotic arms medially, thereby changing the angle of the instruments. Dissecting a large prostate can leave a large bladder neck; this can be reconstructed by interrupted sutures of 20 polyglactin on an RB1 needle at the 3 and 9 o'clock positions, bringing the anterior and posterior wall together. The bladder neck is tailored to match the urethral diameter.

REFERENCES

- Schuessler WW, Schulam PG, Clayman RV, Kavoussi LR. Laparoscopic radical prostatectomy: initial short-term experience. *Urology* 1997; **50**: 854
- Guillonneau B, Vallancien G. Laparoscopic radical prostatectomy: the Montsouris technique. *J Urol* 2000; **163**: 1643
- Abbou CC, Salomon L, Hoznek A *et al.* Laparoscopic radical prostatectomy: preliminary results. *Urology* 2000; **55**: 630–4
- Kavoussi LR. Laparoscopic radical prostatectomy: irrational exuberance? *Urology* 2001; **58**: 503–5
- Menon M, Shrivastava A, Tewari A *et al.* Laparoscopic and robot assisted radical prostatectomy: establishment of a structured program and preliminary analysis of outcomes. *J Urol* 2002; **168**: 945–9
- Kaul S, Bhandari A, Hemal A, Saveri A, Shrivastava A, Menon M. Robotic radical prostatectomy with preservation of the prostatic fascia: a feasibility study. *Urology* 2005; **66**: 1261–5
- Van Velthoven RF, Ahlering TE, Peltier A, Skarecky DW, Clayman RV. Technique for laparoscopic running urethrovesical anastomosis: the single knot method. *Urology* 2003; **61**: 699–702

Correspondence: Alok Shrivastava, Vattikuti Urology Institute, Henry Ford Health System, 2799 West Grand Blvd., Detroit, MI, 48202, USA.

e-mail: ashri1@hfhs.org