RAPID COMMUNICATION

LATERAL PEDICLE CONTROL DURING LAPAROSCOPIC RADICAL PROSTATECTOMY: REFINED TECHNIQUE

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ABSTRACT

Objectives. To report a technique of lateral pedicle control during laparoscopic radical prostatectomy that completely eliminates any form of electrocautery, ultrasonic thermal energy, clips, or bioadhesives.
Methods. The technique was used in 25 men undergoing nerve-sparing laparoscopic radical prostatectomy. Our antegrade technique involves transient control of the lateral prostate pedicles with an atraumatic vascular bulldog clamp. The pedicles were divided by precise cold cutting, and the neurovascular bundles (NVBs) were teased away with gentle blunt and sharp dissection. Hemostasis was secured with meticulous, superficial suturing of transected blood vessels with 4-0 Vicryl. Real-time transrectal ultrasound monitoring was performed preoperatively, during bulldog clamp application, and postoperatively.
Results. The mean bulldog clamp time for the right and left prostate pedicles was 11.1 and 11.2 minutes, respectively. Transrectal ultrasonography confirmed continued arterial blood flow within NVB during active bulldog clamping. Before clamping, during clamping, and after prostatectomy, the mean number of visible blood vessels within each NVB was 3.4, 2.2, and 2.1 ($P < 0.001$ before versus during or after), and the mean resistive index of arterial blood flow was 0.86, 0.85, and 0.85, respectively. Positive surgical margins occurred in 1 patient (4%). Potency and continence data are awaited.
Conclusions. We describe a technique of lateral pedicle ligation during laparoscopic radical prostatectomy using monitored cold cutting and delicate 4-0 hemostatic suturing that completely eliminates all electrocautery, ultrasound thermal energy, clips, and bioadhesives. Bulldog clamp placement on the lateral prostate pedicles did not interrupt blood flow within the NVB. UROLOGY **65:** 23–27, 2005. © 2005 Elsevier Inc.

Laparoscopic radical prostatectomy (LRP) is increasingly performed at specialized centers worldwide. With gathering experience, the laparoscopic technique is being refined in an attempt to emulate established open techniques. The delicate neurovascular bundle (NVB) is intimately related to the posterolateral surface of the prostate. As such, complete avoidance of any thermal or electrical energy during lateral pedicle transection and NVB release comprises a hallmark principle during open surgery.[1] Recently, Ong *et al.*[2] provided evidence in the survival canine model that the use of hemostatic energy sources (monopolar cautery, bipolar cautery, ultrasound scissors) during NVB release was associated with significantly decreased erectile response to cavernous nerve stimulation. However, the use of conventional dissection with hemostatic suture ligatures did not compromise the erectile response to nerve stimulation.[2] Current laparoscopic and robotic techniques for lateral pedicle transection fall short in this important regard, typically using either monopolar or bipolar electrocautery, or ultrasound energy with the harmonic scalpel, with or without clips.[3–7] We describe a laparoscopic technique of lateral pedicle control by transrectal ultrasound (TRUS)-monitored cold cutting and precise hemostatic suturing, thereby completely eliminating any thermal energy (electrical or ultrasonic), clips, and bioadhesives.

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MATERIAL AND METHODS

The technique was used in 25 potent men undergoing LRP with either bilateral (n = 22) or unilateral (n = 3) nerve sparing. The mean patient age was 58.8 years, the mean preoperative prostate-specific antigen level was 4.9 ng/mL, and the mean biopsy Gleason score was 6.2. The clinical stage was

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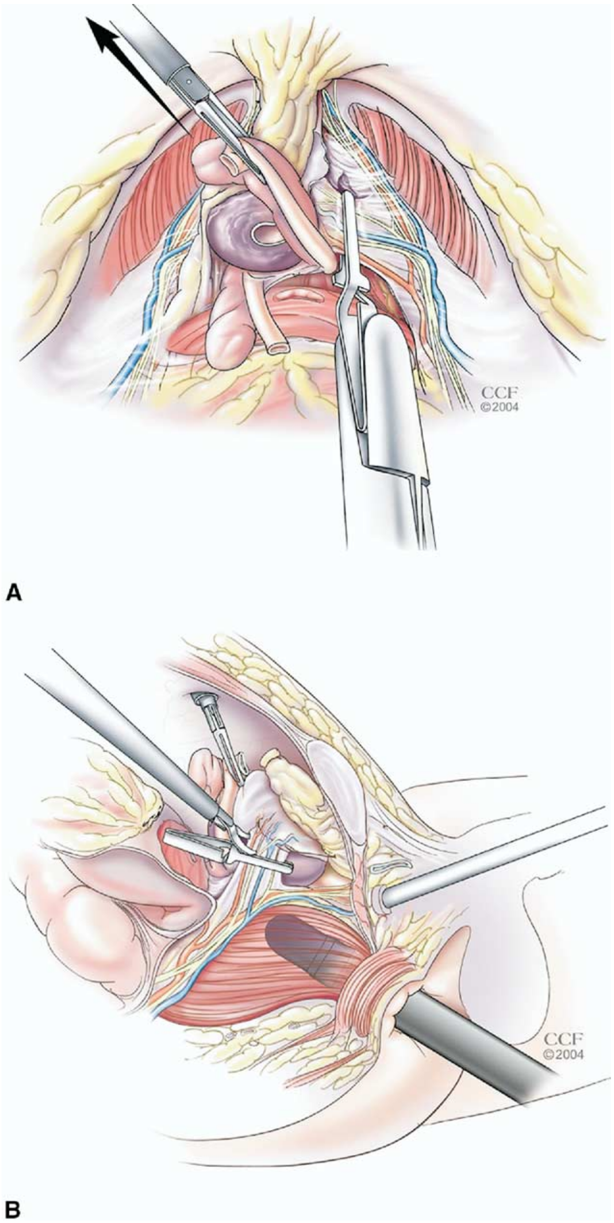

FIGURE 1. *(A) Bulldog clamp in position on right prostate pedicle. (B) Cold cutting of pedicle under real-time TRUS probe monitoring. Reprinted with the permission of The Cleveland Clinic Foundation.*

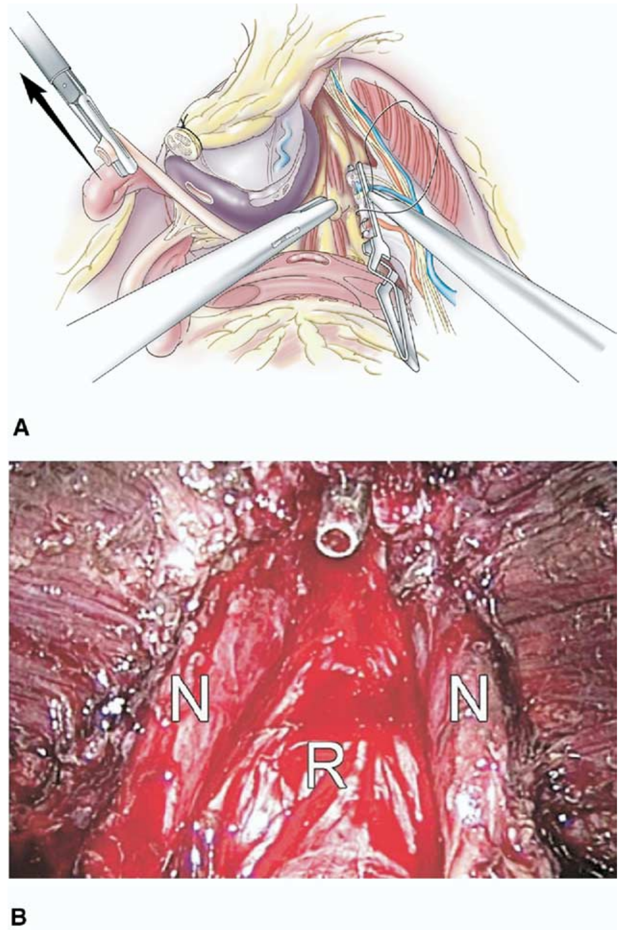

FIGURE 2. *(A) Meticulous, superficial suturing (4-0 Vicryl) of transected lateral pedicle. (B) Intraoperative laparoscopic view of bilateral preserved NVBs (N) after laparoscopic prostatectomy. Note, no thermal energy, clips, or bioadhesives were used. R = rectum. Reprinted with the permission of The Cleveland Clinic Foundation.*

T1c in 20 men (80%), T2a in 4 (16%), and T2b in 1 (4%). All data were collected and analyzed after obtaining institutional review board approval.

TECHNIQUE

A six-port transperitoneal laparoscopic approach was used, as previously described.[6] A TRUS probe (Probe types 8808, type 2102 Hawk, B-K Medical, Copenhagen, Denmark) was inserted into the rectum, and preoperative measurements of the prostate and NVBs were obtained.[8] Care was taken not to use any electrocautery or ultrasound energy along the tip and lateral surface of the seminal vesicle owing to its proximity to the NVB. A Hem-o-Lok clip (Weck Closure Systems, Research Triangle Park, NC) is placed to control the artery to the seminal vesicle, which was then transected with cold scissors. Denonvilliers' fascia was incised, entering the prerectal space along the posterior surface of the prostate.

The right lateral pedicle and NVB were addressed initially. Bilateral seminal vesicles and vas deferens, grasped by an atraumatic bowel clamp introduced through the 5-mm suprapubic port, were tautly retracted anterolaterally to the left side, placing the right lateral pedicle of the prostate on gentle stretch. A 25-mm, straight, atraumatic bulldog clamp (CEV565, MicroFrance Medtronic Xomed, Jacksonville, Fla) was placed obliquely at a 45° angle across the right lateral pedicle close to the bladder neck, at some distance from the right posterolateral edge of the prostate (Fig. 1A). Using cold Endoshears, the lateral pedicle was carefully divided in small tissue bites, leaving an approximately 1 to 2-mm edge of pedicle tissue protruding from the jaws of the bulldog clamp (Fig. 1B). TRUS imaging provided real-time guidance along the posterolateral edge of the prostate, thus minimizing inadvertent compromise of the prostatic capsule. As the last few remaining attachments of the lateral pedicle were divided, the NVB becomes visible. At this point, a combination of minute sharp scissor cuts and gentle blunt teasing with a soft laparoscopic Kittner released the NVB in an antegrade manner along the convexity of the prostate toward the apex. Care must be taken to maintain the prostatic capsule intact along the posterolat-

TABLE I. ***Transrectal ultrasound data***

Right NVB	
Visible vessels (n)	
Before pedicle clamping	3.6 ± 1.0
During pedicle clamping	2.3 ± 1.1*
After release of NVB	2.4 ± 1.2†
Resistive index	
Before pedicle clamping	0.86 ± 0.04
During pedicle clamping	0.86 ± 0.06‡
After release of NVB	0.84 ± 0.06§
Dimensions of NVB	
Preoperative (mm)	4.9 ± 0.6 × 4.5 ± 0.8
After prostatectomy (mm)	4.5 ± 0.7 × 4.3 ± 0.9
Reduction in cross-sectional area of NVB (%)	12.2
Left NVB	
Visible vessels (n)	
Before pedicle clamping	3.3 ± 1.1
During pedicle clamping	2.1 ± 0.7*
After release of NVB	1.8 ± 1.2†
Resistive index	
Before pedicle clamping	0.86 ± 0.05
During pedicle clamping	0.84 ± 0.07‡
After release of NVB	0.86 ± 0.05§
Dimension of NVB	
Preoperative (mm)	4.8 ± 0.8 × 4.6 ± 0.9
After prostatectomy (mm)	4.5 ± 0.9 × 4.3 ± 0.7
Reduction in cross-sectional area of NVB (%)	12.4

Key: NVB = neurovascular bundle.
* *P <0.001 before vs. during.*
† *P <0.001 before vs. after.*
‡ *Not significant, before vs. during.*
§ *Not significant, before vs. after.*

eral and lateral edge of the prostate. Because thermal energy (cautery or ultrasound) is avoided completely, the color and texture of the tissues at this important location remain pristine. Because of this clear visualization, even a minute inadvertent prostatic capsulotomy can be immediately identified and sharply corrected, thereby staying in the correct plane outside the prostatic fascia.

At this time, a 4-0 Vicryl suture on an RB-1 needle (suture length 6 to 8 cm) was used to suture the transected lateral pedicle superficially (Fig. 2A). The initial stitch was placed at the proximal cut end of the lateral pedicle close to the bladder neck. One to two additional small suture bites were taken superficial to the jaws of the closed bulldog clamp to anchor the stitch. The bulldog clamp was removed, and any bleeding vessels were meticulously sutured for hemostasis (Fig. 2B). Typically, four to six running suture bites were necessary. In a similar manner, the left lateral pedicle was transected and the NVB released.

The prostate apex was mobilized, and both NVBs were gently dissected away from the prostate apex. The urethra was sharply transected with cold Endoshears, the specimen was entrapped, NVB hemostasis was confirmed, and urethrovesical anastomosis was completed with a running suture.

TRUS measurements were obtained before application of the bulldog clamp, during application of the bulldog clamp, and at prostatectomy completion. The TRUS parameters evaluated included the dimensions of the NVBs, number of visible vessels, and resistive index of arterial flow within NVB, as described by us previously.[8]

RESULTS

The mean bulldog clamp time was 11.1 minutes on the right prostate pedicle and 11.2 minutes on the left prostate pedicle. The average estimated blood loss was 334 mL, operative time 254 minutes, hospital stay 1.6 days, and catheter duration 5.4 days. No patient required a blood transfusion, and no intraoperative complications occurred.

Laparoscopic transection of the lateral pedicles and release of the NVBs could be consistently monitored in real time by transrectal power Doppler, as well as by gray-scale ultrasonography. The mean number of visible blood vessels within each NVB was 3.4, 2.2, and 2.1, before clamping, during clamping, and after prostatectomy, respectively ($P < 0.001$ before versus during or after; Table I). Definitive arterial flow within the NVBs using TRUS power Doppler spectral waveform analysis was documented before, during, and after pedicle clamping (Fig. 3). The mean arterial blood flow resistive index in the NVBs remained unchanged: 0.86, 0.85, and 0.85 before clamping, during clamping, and after prostatectomy, respectively.

Of the 25 patients, bilateral nerve sparing was performed in 22. In 3 patients with Stage pT3a disease

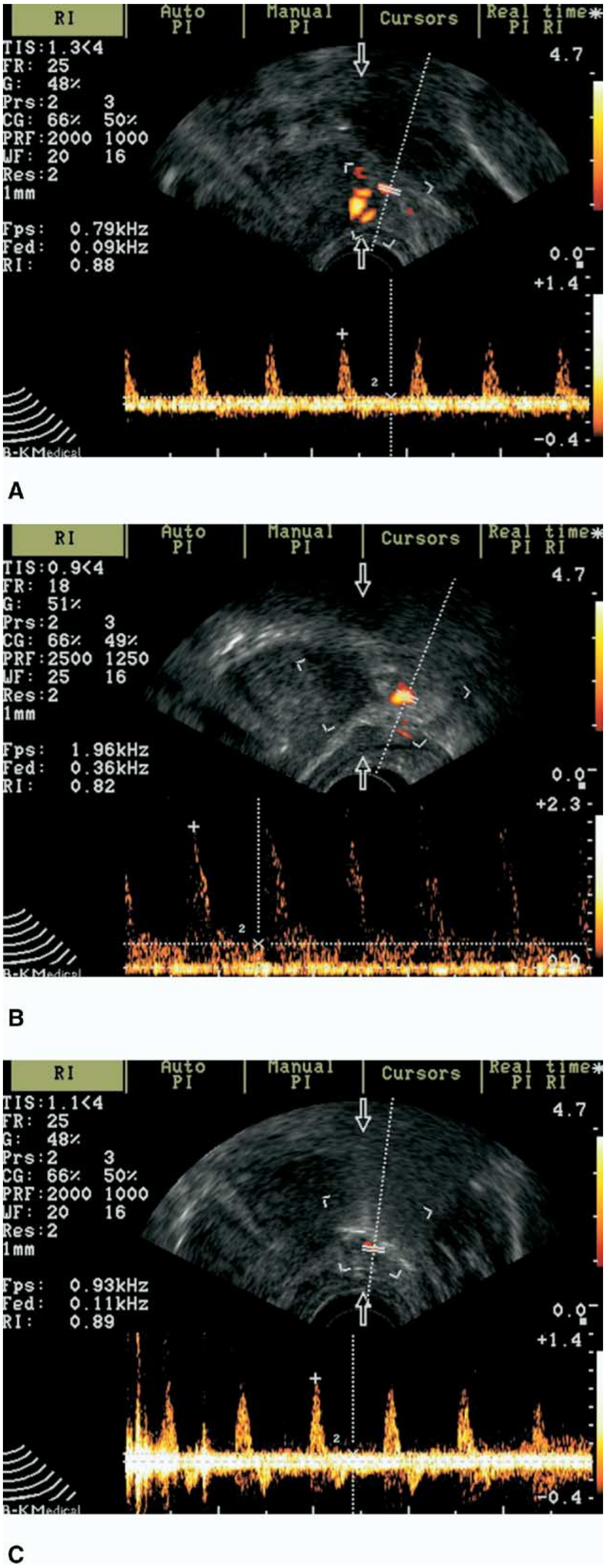

FIGURE 3. *Spectral waveform analysis using power Doppler TRUS identified arterial blood flow within NVB and allowed measurement of resistive index (RI) of arterial flow within NVB. Uninterrupted arterial blood flow within NVB was documented (A) before bulldog clamp placement (RI 0.88), (B) during bulldog clamping (RI 0.82), and (C) after release of NVB (RI 0.89).*

and needle biopsy-proven unilateral high-grade cancer corresponding to intraoperative TRUS findings of ipsilateral large-volume cancer, unilateral nerve sparing was performed, resulting in negative margins in 2 patients. Positive surgical margins were noted in 1 patient (4%) who had Gleason score 8 cancer in which extensive established capsular penetration of up to 2 mm was confirmed on final pathologic examination. The final pathologic evaluation revealed pT2a disease in 3 (12%), pT2b in 19 (76%), and pT3a in 3 patients (12%).

COMMENT

Our technique of LRP has evolved during the course of 500 cases. Initially, monopolar and/or bipolar electrocautery were used, which we soon abandoned for obvious reasons. More recently, we have used the harmonic scalpel, but concerns regarding visible collateral thermal damage remained. Laparoscopic clips (5 mm or 10 mm Weck clip, 9 mm or 11 mm titanium clip) are somewhat large in size for the delicate NVBs. When clip ligating the lateral pedicle, care must be taken to avoid mechanical clip injury to the delicate nerve fibers. Furthermore, clip application of the minute, multiangled, short, perforating branches from the NVB must be oriented parallel to the NVB. In our experience, precise control of a transected lateral pedicle arterial bleeding vessel with a clip is difficult without incorporating adjacent NVB tissue. Extrapolating from our experience with hemostatic bioadhesives during laparoscopic partial nephrectomy,[9] we evaluated the use of FloSeal (Baxter Medical, Fremont, Calif) during nerve-sparing LRP. In our experience, FloSeal could not achieve reliable hemostasis of bleeding vessels from the prostate pedicle and the NVB, often requiring additional clip placement or bipolar electrocautery. Another important issue is the healing process after topical application of bioadhesives, which may result in reactionary fibrosis, exuberant lymphocytic infiltrate, and an inflammatory response.[10] Although the specific effect of topical FloSeal on the healing and functional recovery of cavernous nerve fibers is unknown, this potential for local toxicity dissuaded us from its use. As such, our current technique includes transient atraumatic control of the lateral pedicles with a bulldog clamp, and monitored cold cutting with precise 4-0 hemostatic suturing, thereby completely eliminating all electrocautery, ultrasound thermal energy, clips, or bioadhesives.

Our described technique raises certain issues. The major structure controlled by the bulldog clamp is the lateral pedicle containing the distal branches of the inferior vesical artery to the prostate base and bladder neck—not the NVB. The primary question is whether bulldog clamping of the prostate pedicle causes trauma to the nerves within the NVB. TRUS demonstration of continued pulsatile blood flow within each NVB during active bulldog clamping is encouraging, in that it suggests that minimal occlusive pressure is imposed on the actual NVB itself. It is our impression that the lateral prostate pedicle is thicker in size than its underlying thinner NVB. As such, placement of the bulldog clamp on the overlying bulkier prostate pedicle likely does not compress the underlying NVB. The resistive index of arterial flow within each NVB did not change. Also, some bleeding still occurred from the transected blood vessels of the lateral pedicle, indicative of the relatively gentle occlusive force of the bulldog clamps. As such, direct trauma to the cavernous nerve fibers is unlikely. Finally, and importantly, the potency and continence data, necessary to validate the functional outcomes of this technique, are still awaited.

CONCLUSIONS

In developing this laparoscopic technique, a rigorous attempt has been made to integrate the identical concerns and technical considerations that are routine during established open nerve-sparing radical prostatectomy. Monitored cold-cutting and delicate 4-0 hemostatic suturing of the lateral pedicles completely eliminates the need for all electrocautery, ultrasound thermal energy, clips, and bioadhesives. Bulldog clamp placement on the lateral prostate pedicles did not interrupt blood flow within the NVB.

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