Impact of Cautery versus Cautery-Free Preservation of Neurovascular Bundles on Early Return of Potency

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ABSTRACT

Purpose: To update our short-term potency outcomes from a cautery-free (CFT) versus bipolar cautery technique to preserve the neurovascular bundles (NVB) during robotic laparoscopic radical prostatectomy (RLP).

Patients and Methods: Previously, we reported on 3-month potency outcomes in 23 men, which we now extend to 51 men. All men met three criteria: age <66 years, Sexual Health Inventory in Men (SHIM-5) score of 22 to 25, and either unilateral or bilateral NVB preservation at LRP. Group 1 (N = 51), the study group, had preservation of the NVB with CFT. Group 2 (N = 36) had traditional dissection using bipolar cautery. The average age and preoperative SHIM scores were similar for the two groups. Data were collected prospectively via validated questionnaires. Potency was defined as an erection adequate for vaginal penetration. All men were asked to estimate the fullness of erections compared with baseline (preoperative).

Results: The average age and preoperative SHIM scores were similar for both groups. The rate of potency at 3 months was 47% (24/51) in group 1 versus just 8.3% (3/36) in group 2 (P < 0.001). Additionally, only 9 of 25 CFT patients (36%) reported zero fullness compared with 15 of 22 patients (68%) in the bipolar cautery-treated group (P = 0.03).

Conclusions: With expanded experience, there was no change in 3-month return of sexual function (47%) compared with our initial publication. This result further supports the importance of avoiding cautery when controlling the vascular pedicle and dissecting the NVB.

INTRODUCTION

THE ANATOMIC BASIS of preservation of erectile function and the technique for nerve-sparing radical retropubic prostatectomy (RP) was described by Walsh and associates in 1983.1 Numerous techniques for cavernous-nerve preservation have been developed over the past 20 years.2-5 Emphasis has been placed on proper anatomic dissection of the apex of the prostate with retrograde dissection of the prostate, popular with RP surgeons. However, in laparoscopic radical prostatectomy (LRP), surgeons generally prefer an antegrade approach because of the geometry of the pelvis and the employment of long, straight instruments.6,7 A disadvantage of the antegrade approach used in LRP is the need to divide the vascular pedicle prior to dissecting the neurovascular bundles (NVB). The choices for controlling the vascular pedicle include laparoscopic vascular clips or thermal energy (monopolar or bipolar cautery, Harmonic Scalpel, etc.).

In an animal study evaluating function of the NVB after dissection with three forms of thermal energy, Ong and associates8 demonstrated the caustic effect of thermal energy near the NVB. In 2005 and nearly simultaneously, we described robotic prostatectomy with cautery-free dissection of the NVB,9 while Gill and associates10 described cautery-free dissection in standard LRP. Our initial short-term outcomes, reported in 2005, demonstrated a significant improvement in the 3-month potency rates compared with our previous (thermal) technique. In the present paper, we report our experience with the cautery-free technique (CFT) for dissecting the NVB in a larger patient population.

PATIENTS AND METHODS

In February 2004, we began using temporary vascular occlusion of the prostatic vascular pedicle utilizing laparoscopic bulldog clamps, much like those used for partial nephrectomy. Table 1 depicts the study groups. The inclusion requirements were <66 years of age plus a Sexual Health Inventory in Men (SHIM-5) score of 22 to 25. Group
1 is the initial 23 men, reported previously, identified from a series of 75 cases (Nos. 168–243) who underwent nerve-sparing robotic LRP with CFT plus an additional consecutive 28 similarly treated men, with the new patients coming from a total of 150 consecutive men (Nos. 168 to 318). The control group (group 2) is the same as previously published and includes 36 men from a consecutive group of 110 men who underwent bipolar cautery during nerve-sparing surgery (Nos. 15–125). The groups had nearly identical preoperative characteristics, and groups 1 and 2 were similar for factors such as Body Mass Index (BMI) that might affect potency (Table 1). Patients were excluded if they were subsequently placed on hormonal therapy. All procedures were performed by a single surgeon (TA).

A complication was defined as the need for prolonged (>2-day) hospitalization, a return to the operating room, referral to intensive care, or the need for readmission within 1 month of surgery. Operative complications potentially attributable to the CFT such as bleeding and pelvic hematoma were specifically noted. Outcomes were obtained via validated self-administered questionnaires (seven-item International Prostate Symptom Score [IPSS], five-item SHIM, and selected questions from the EPIC-26). Potency was defined as erections with sufficient firmness for vaginal penetration with or without oral phosphodiesterase inhibitors. Men were considered potent if they answered yes to the question, “Have you had an erection (firm enough) for penetration” and a score of 2 or more for question 2 of the SHIM-5 (i.e., How often were erections hard enough for penetration? [see Appendix]).

For all men, and particularly those who indicated inability to have an erection, we attempted to make a qualitative estimate of partial return of erections. Men were asked to rate their fullness of erection; i.e., 0, 25%, 50%, 75%, or 100% in comparison with their preoperative capability. A non-clinical research associate (DS) collected follow-up information.

All statistical comparisons between the groups were two-sided using Fisher’s exact test and the Student t-test for means (SAS 8.2 statistical package).

The operative technique has been previously described,9,11 In brief, after the rectum is freed from the prostate, the vascular pedicles are thinned to allow placement of 30-mm laparoscopic bulldog clamps, and the NVB are dissected free of the prostatic capsule gently and completely using scissors (Fig. 1). Control of the vessels in the vascular pedicles is achieved using a running 3-0 polyglycolic acid suture ligature. Although no specific protocol is in place, all patients in both groups were encouraged to use phosphodiesterase inhibitors except those patients in whom such drugs were contraindicated or who did not tolerate the medication.

**RESULTS**

Blood loss and complications were very similar in groups 1 and 2. The one complication in group 2 was a urine leak that resolved with simple drainage without sequelae. No patient in either group required a transfusion or suffered from intraoperative or postoperative (delayed) bleeding. Six of the 36 men group 2 (16.7%) had a positive margin whereas only 6 of the 51 men in group 1 (11.6%) did (P = NS). None of the men in group 1 had a positive margin laterally along the NVB, all six positive margins being at the apex.

Table 2 displays the potency results. As noted, group 1 had nearly a fivefold greater number within early return of sexual function. Irrespective of technique, the ability to have erections adequate for vaginal penetration has a significant effect on SHIM scores. The average SHIM score for potent versus “impotent” patients at 3 months was 18.6 ± 2.3 in men who reported inadequate erections. At 3 months, 68% (15 of the 22 men who responded) in group 2 rated their erections as zero compared with just 36% (9 of 25 men responding) in group 1 (P = 0.03). The percent of the potent men reporting erections firm enough for penetration 50% of the time or greater (question 2; score ≥3) was 67. The percent of men with a SHIM score ≥20 was 33, and the percentage with a score of ≥10 was 67.

### Table 1. Clinical Characteristics and Outcomes in Groups 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>Initial (CFT)</th>
<th>Group 1 (CFT)</th>
<th>Group 2 (bipolar)</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>No.</td>
<td>23</td>
<td>51</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>55.7 (48–65)</td>
<td>56.7 (48–65)</td>
<td>56.5 (43–65)</td>
<td>NS</td>
</tr>
<tr>
<td>Preoperative SHIM</td>
<td>24.3</td>
<td>24.4 (22–25)</td>
<td>24.3 (22–25)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean PSA (ng/mL)</td>
<td>5.9 (1.2–16.8)</td>
<td>5.5 (0.5–16.8)</td>
<td>6.6 (1.2–23.0)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean Gleason Score</td>
<td>6.4</td>
<td>6.4</td>
<td>6.4</td>
<td>NS</td>
</tr>
<tr>
<td>No. of nerve-sparing procedures (%)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Bilateral</td>
<td>17 (74)</td>
<td>38 (75)</td>
<td>28 (78)</td>
<td>NS</td>
</tr>
<tr>
<td>Unilateral</td>
<td>6 (26)</td>
<td>13 (25)</td>
<td>8 (22)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean estimated blood loss (mL) (range)</td>
<td>107 (50–225)</td>
<td>107 (50–225)</td>
<td>86 (25–250)</td>
<td>0.07</td>
</tr>
<tr>
<td>Mean length of stay (days) (range)</td>
<td>1.1 (1–2)</td>
<td>1.1 (1–2)</td>
<td>1.1 (1–5)</td>
<td>NS</td>
</tr>
<tr>
<td>Complications (%)</td>
<td>0</td>
<td>1 (2.0)</td>
<td>1 (2.7)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Previously reported (reference 11).*
DISCUSSION

The object of nerve-sparing radical prostatectomy is to remove the prostate without removing or transecting the NVB. Additionally, it has become increasingly evident that preservation of the nerves may be achieved, yet trauma to the nerves can reduce, delay, or prevent recovery of erectile function.

Most laparoscopic surgeons employ an antegrade approach to the vascular pedicles and NVB. In order to control the pedicles, laparoscopic hemo-clips may be applied to the multiple arteries feeding the prostate. To avoid bothersome bleeding secondary to imprecise clip placement or thick tissue bundles, LRP surgeons generally employ some form of thermal energy to maintain hemostasis. Electrocautery, monopolar or bipolar, is known to cause primarily thermal injury to neural tissue in near proximity. Most studies evaluating neural injury have used a myelinated nerve such as the rat’s sciatic nerve. The cavernosal nerve is an unmyelinated autonomic nerve that may be more susceptible to damage than thicker myelinated nerves. Donzelli and associates have shown that temperatures as low as 41°C can cause injury to neural tissue. Alternative sources such as ultrasonic energy have been introduced in an attempt to reduce tissue injury. However, the temperature of the blade of ultrasonic shears rises to 63°C or higher with as little as 3 seconds of application.

Ong and associates published the most significant study of thermal injury to the cavernosal nerve. In a canine model, they compared monopolar, bipolar, and harmonic energy sources with conventional (no-energy) dissection of the NVB and measured intracavernous pressures (ICP) immediately and 2 weeks after dissection. The three groups demonstrated dramatic reduction in ICP, both immediately and later. In fact, all three groups demonstrated a >95% reduction in ICP at 2 weeks compared with normal ICP in the conventional and control groups. The alternative—simply cutting the vascular pedicles and then dissecting the NVB—is not practical, as vision is critical with LRP and even small amounts of bleeding interfere.

As mentioned, we previously reported a significant increase in the return of sexual function 3 months after surgery when we used a cautery-free means of transecting the prostatic vascular pedicle and dissecting the NVB. The point of the present study was to expand the experience to see if our continuing results support the early findings. As Table 1 illustrates, the groups had nearly identical preoperative clinical data. Table 2 shows that as our experience grew, our results with the CFT remained stable (43% versus 47%; P = NS). Also, the expanded group of 51 patients increases the statistical power of the nearly sixfold greater increase in return of sexual potency (47% versus 8.3%; P < 0.001) within 3 months. In addition to reporting on potency, patients concomitantly filled out SHIM forms, and it is clear from these scores that vaginal penetration is accompanied by more global sexual satisfaction. “Potent” men in group 1 had an average SHIM score of 18.0 compared with 2.3 for the impotent men.

<table>
<thead>
<tr>
<th>Table 2. Comparison of Potency at 3 Months</th>
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<tbody>
<tr>
<td><strong>Initial</strong> (CFT) (N = 23)</td>
</tr>
<tr>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>No. (% ) potent @ 3 mos 10/23 (43)</td>
</tr>
<tr>
<td>Bilateral nerve sparing 8/17 (47)</td>
</tr>
<tr>
<td>Unilateral nerve sparing 2/6 (33)</td>
</tr>
<tr>
<td>Mean SHIM (potent men) 15.7</td>
</tr>
<tr>
<td>No. (% ) with zero fullness 2/13 (15)</td>
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*aFisher exact test, 2-sided; group 1 v group 2.
At present, there are no established means to measure partial recovery of erectile function in “impotent” men. We have attempted to address partial recovery qualitatively by asking patients about erectile fullness. Assessing partial recovery; i.e., 25% to 75% fullness, as opposed to no recovery, 0, arguably presents at least some qualitative assessment. Again, in support of CFT, only 36% of this group reported zero fullness in the first 3 months of follow-up vs nearly 70% of the group treated with bipolar cautery.

A finding of interest is the relatively high rate of potency preservation in patients undergoing unilateral nerve sparing. A possible explanation for this finding is cross coverage and regenerative compensation. Although the numbers are relatively small, it has been a consistent finding. Time will tell if these findings are simply a result of an inadequate sample size.

Potential biases in this study arise from the sequential nature of the bipolar and CFT groups and thus increasing surgical experience. In order to minimize this potential, patients from the bipolar-cautery group were culled from men treated after our initial learning curve. Of note, the three men with early return of potency were treated during the early and mid portion of the bipolar-cautery experience. Additionally, other subtle changes, such as performing the dissection of the left NVB with the scissors in the left hand, did not result in obvious changes in potency. Hence, the improvement in potency was so abrupt and significant with CFT that it seems unlikely the improvement occurred as a consequence of a learning curve. A randomized trial would be necessary to eliminate these concerns.

CONCLUSION

The strength of this study is the use of validated questionnaires in defined patient populations. Absence of cautery during dissection of the NVB improves erectile function significantly within the first 3 months, along with the average SHIM score for potent men and fullness of partial erections in recovering men. The results strongly support the findings of Ong and associates that dissection of the NVB without cautery is very important for early return of erectile function.

APPENDIX

SHIM Question 2
When you had erections with sexual stimulation, how often were your erections hard enough for penetration (entering your partner)?
0 No sexual activity
1 Almost never or never
2 A few times (much less than half the time)
3 Sometimes (about half the time)
4 Most times (much more than half the time)
5 Almost always or always

REFERENCES