Identification of the retrotrigonal layer as a key anatomical landmark during robotically assisted radical prostatectomy

Ashutosh Tewari, Assaad El-Hakim, Sandhya Rao and Jay D. Raman
Department of Urology, The New York-Presbyterian Hospital, Weill Medical College of Cornell University, New York, NY, USA
Accepted for publication 15 May 2006

OBJECTIVE

To define the gross and microscopic anatomy, and the surgical significance, of the newly described retrotrigonal layer of the bladder neck, as an aid during robotic radical prostatectomy (RRP).

MATERIALS AND METHODS

The data for this study were obtained from five fresh cadaveric dissections and 100 consecutive RRPs. Five male cadavers with no previous pelvic or urethral surgery were dissected to expose the posterior bladder neck and identify the retrotrigonal layer. This same layer was reproducibly identified in all 100 RRPs. The gross appearance of this layer, and its relationship to neighboring structures, was documented using still photographs and intraoperative video. The microscopic composition of this layer was assessed using routine haematoxylin and eosin stains, and special staining for smooth muscle (desmin), neural tissue (S-100), and elastin.

RESULTS

Grossly, the retrotrigonal layer is a well-defined midline strip located posterior to the bladder neck, that extends from the trigone (superiorly) to the base of the prostate (inferiorly). Microscopically, this layer was predominantly composed of smooth muscle with intervening connective tissue. The retrotrigonal layer serves as a key anatomical landmark to facilitate posterior prostatic dissection, particularly in men with large prostates, prominent median lobes, or previous transurethral prostatic surgery. Further, in our practice, this layer marks the posterior limit of dissection in which electrocautery is still used. Finally, the retrotrigonal layer serves to buttress the posterior layer of the urethrovesical anastomosis.

CONCLUSION

The retrotrigonal layer is a key landmark during the posterior bladder neck dissection in the antegrade technique of RRP.

KEYWORDS

radical prostatectomy, antegrade approach, robotic surgery, retrotrigonal layer, anatomy

INTRODUCTION

The antegrade approach used during robotic radical prostatectomy (RRP) can be challenging. Choosing the appropriate posterior plane after transecting the bladder neck can be difficult with no
preliminary seminal vesicle dissection through the pouch of Douglas [1]. This is particularly true in men with large
prostates, prominent median lobes, or previous transurethral surgery [2]. In the process of refining the steps of the RRP
we encountered a consistent, well-defined midline layer of tissue located posterior to the bladder neck, extending from the trigone
(superiorly) to the base of the prostate (inferiorly). We subsequently referred to this tissue as the ‘retrotrigonal layer.’ Herein we
report our findings in both cadaveric dissections and RRP s on the gross and microscopic anatomy, and the surgical
significance, of this newly described retrotrigonal layer.

MATERIALS AND METHODS

The aim of this study was to define the gross anatomy and relationships with neighbouring structures, to assess the histopathology, and
to describe the surgical importance of the retrotrigonal layer. The data for this study were obtained from five fresh cadaveric
dissections and 100 consecutive RRP s at the New York-Presbyterian Hospital Weill-Cornell Medical Center.

Five male cadavers (aged >40 years) with no previous pelvic or urethral surgery were
selected. Cadavers were initially frozen 12–36 h after death and subsequently stored at −20 °C until dissection. No macroscopic
tumours were evident in the abdominal or pelvic regions of these cadavers. The dissections were performed using a high-
power operating microscope. The emphasis of the cadaveric studies was to carefully dissect the posterior bladder neck and identify the
retrotrigonal layer. The dimensions of this layer were measured and thin sections were taken for histopathological examination. The relationship with the bladder neck, ureteric
orifices, vas deferens, seminal vesicles, prostatic pedicles and pelvic plexus was noted. The findings were documented using
still photographs and a video camera. Tissues were fixed and routine haematoxylin and eosi n (H&E) staining used; specialized staining
was used for smooth muscle (desmin), neural tissue (S–100), and elastin, to evaluate the tissue composition in selected cases.

The surgical anatomy of the posterior bladder neck was studied in 100 consecutive RRP s at
our institution. The transperitoneal RRP operation was described previously [1,3].
Briefly, the athermal technique involves restricting the use of thermal energy in the region around the pelvic plexus and the
neurovascular bundles (NVBs). This technique enables preservation of not only the main NVBs but also safeguards the branches of the pelvic plexus. One of the most challenging steps of antegrade RP is dissecting the bladder neck. In the midline, the bladder
muscle and the prostate are intimately juxtaposed. After dividing the anterior bladder neck, the posterior bladder neck is divided in
the midline at the prostato-vesical junction. At this stage, the retrotrigonal layer was identified and real-time videos used to
document its gross structure and the neighbouring structures. Tissue biopsies from the retrotrigonal layer were fixed and stained
as previously described. The retrotrigonal layer was then divided athermally and the vas, seminal vesicles and prostatic pedicles
subsequently dissected. Electrocautery was avoided for the entire posterior dissection beyond the retrotrigonal layer, to minimize
potential thermal damage of the NVBs.

RESULTS

The retrotrigonal layer was clearly identified in all five cadaveric dissections and all 100
RRP s, as a pinkish white midline strip with vertically orientated fibres that extended posterior to the bladder neck from the bladder
trigone (superiorly) to the base of prostate (inferiorly) (Fig. 1). Laterally, the retrotrigonal layer extended to the proximal NV pedicles and the effacing detrusor fibres on the prostatic capsule. Depending on the size of the prostate, the layer was 5–25 mm wide and 8–35 mm long, with a thickness of
0.5–3.5 mm, with the superior aspect adjacent to the bladder being the thickest and the inferior aspect at the prostatic base being
the thinnest. This layer was best visualized when thermal energy was not used, thus
avoiding changes in tissue colour and texture secondary to desiccation, coagulation and
necrosis.

Histologically, H&E and desmin staining confirmed that this layer is predominantly
composed of smooth muscle, with small areas of intervening connective tissue (Fig. 2A,B).
There was no evidence of elastic tissue (Fig. 2C), and staining with S–100 for neural
tissue (Fig. 2D) showed only several microscopic fascicles of nerves (marked by
arrows) within the retrotrigonal layer. These fascicles probably represent nerves innervating the adjacent seminal vesicles.

The retrotrigonal layer forms the anterior boundary of a space that contains the vasa

**FIG. 1.** The intraoperative appearance of the retrotrigonal layer; the layer is elevated for identification with the robotic scissors. It appears as a pinkish white midline strip with vertically orientated fibres that extended posterior to the bladder neck from the bladder trigone (bottom of this picture) to the base of prostate (top of this picture). Magnification ×10.
deferentia, seminal vesicles, loose areolar tissue, blood vessels, nerves and ganglia. Posteriorly, this space is abutted by Denonvilliers’ fascia. The superior boundary of this space is the trigone of the bladder, the inferior boundary is the base of the prostate, and laterally lies the proximal NV plate including the pelvic plexus, ganglia, vessels and prostatic pedicle (Fig. 3). The retrotrigonal layer is interposed between the deep detrusor fibres and the vas deferens and seminal vesicles.

The retrotrigonal layer plays a key role in the RRP by providing a clear, reproducible landmark to identify the posterior plane of prostatic dissection. After transecting the posterior bladder neck, the natural tendency is to immediately continue dissection distally, which will lead to capsular incision at the base of the prostate. Further, over-correcting proximally might result in an inadvertent cystotomy in the trigone or posterior bladder. In our practice, this layer orients us to the location of the vas deferens and seminal vesicles, and guides the dissection into this plane. It is particularly valuable for orientation in those patients with challenging anatomy, e.g. a large prostate, prominent median lobes, or previous transurethral prostatic surgery. Further, the retrotrigonal layer marks the posterior limit of dissection in which we use electrocautery. Finally, this layer serves to buttress the posterior layer of the urethrovesical anastomosis.

**DISCUSSION**

Bladder neck dissection is a challenging step during RRP; it is important for the surgeon to be familiar with the anatomy, as the antegrade dissection proceeds differently from the open retrograde approach [4]. Anatomically, the base of the bladder rests on the rectum, with the seminal vesicles, vas deferens and the rectovesical pouch of Douglas partially intervening. Superiorly, the prostatic base is juxtaposed to the bladder trigone, and posteriorly, the prostate intimately contacts Denonvilliers’ fascia [5,6]. Choosing the appropriate posterior plane after transecting the bladder neck can be difficult with no preliminary seminal vesicle dissection. Dissection in the incorrect plane might lead to capsular incision of the prostate or an inadvertent cystotomy in the posterior bladder wall.
In the present study, we assessed an anatomical layer located posterior to the bladder neck, which has practical importance during the posterior dissection in RRP. The retrotrigonal layer is a pinkish white midline strip with vertically orientated fibres that extends posterior to the bladder neck from the bladder trigone (superiorly) to the base of prostate (inferiorly). Laterally, the retrotrigonal layer extends to the proximal NV pedicles and the effacing detrusor fibres on the prostatic capsule. We identified this layer in all five cadavers and all 100 RRP. It serves as a key anatomical landmark denoting the posterior extent of the bladder neck dissection. Dissection beyond the retrotrigonal layer leads to exposure of the seminal vesicles and the vasal ampulla.

In the fourth month of fetal development, the rectovesical fascia descends to the pelvic floor [7]. Subsequently, the lower part of the fascia is hypothesised to be obliterated, although remnants of this layer might persist as a plane of cleavage. The anterior lamellae of this condensation might provide the connective tissue component of the retrotrigonal layer. The smooth muscle contribution probably arises from effacing detrusor muscle fibres. We think that this fusion of connective tissue and smooth muscle creates a clearly reproducible layer, that can be used to guide the start of the posterior prostatic dissection.

In our practice, the retrotrigonal layer marks the posterior limit of dissection in which electrocautery is still used. Beyond this point, we use an athermal technique to minimize potential thermal injury to the NVBs and pelvic plexus. While the magnification during RRP might make this dissection more precise, the same philosophy is applicable to both laparoscopic and open RP. Currently, excellent outcomes for potency were reported from studies in which diathermy was used to dissect up to portions of the seminal vesicles [8]. We acknowledge the possibility that heat damage at the tip of the seminal vesicles might be the determining factor in NVB damage, but we have no doubt that our athermal technique starting at the retrotrigonal layer will only further minimize any thermal damage to these nerves. Our future potency data will help to evaluate whether this difference in surgical technique translates to improved patient outcomes. In addition, the retrotrigonal layer serves to strengthen the posterior layer of the urethrovesical anastomosis. We always incorporate the retrotrigonal layer into the posterior aspect of the anastomosis, to buttress the suture line.

To our knowledge, this newly described anatomical landmark has not been described previously. We hope that its identification enriches the confidence of urologists during posterior bladder neck dissection in RRP. In conclusion, the retrotrigonal layer is a key landmark during posterior bladder neck dissection in the antegrade technique of RRP.

CONFLICT OF INTEREST

None declared.

REFERENCES


Correspondence: Ashutosh Tewari, New York-Presbyterian Hospital, Weill Cornell Medical Center, Department of Urology, 525 East 68th Street, Starr 900, New York, NY 10021, USA. e-mail: akt2001@med.cornell.edu

Abbreviations: RRP, robotic radical prostatectomy; NV(B), neurovascular (bundle); H&E, haematoxylin and eosin.