Human Pathology (2012) **43**, 254–260

ELSEVIER

Human PATHOLOGY

www.elsevier.com/locate/humpath

Original contribution

Characteristics of positive surgical margins in robotic-assisted radical prostatectomy, open retropubic radical prostatectomy, and laparoscopic radical prostatectomy: a comparative histopathologic study from a single academic center☆,☆☆

Roula Albadine MD[a], Matthew E. Hyndman MD, PhD[b], Alcides Chaux MD[a], J.Y. Jeong MD[a], Shahrazad Saab MD[a], Fabio Tavora MD[a], Jonathan I. Epstein MD[a,b,c], Mark L. Gonzalgo MD, PhD[b], Christian P. Pavlovich MD[b], George J. Netto MD[a,b,c,*]

[a]*Department of Pathology, The Johns Hopkins Medical Institutions, Baltimore, MD 21231, USA*
[b]*Department of Urology, The Johns Hopkins Medical Institutions, Baltimore, MD 21231, USA*
[c]*Department of Oncology, The Johns Hopkins Medical Institutions, Baltimore, MD 21231, USA*

Received 14 March 2011; revised 13 April 2011; accepted 18 April 2011

Keywords:
Prostate cancer;
Surgical margin;
Biochemical recurrence;
Radical prostatectomy;
Robotic prostatectomy;
Laparoscopic prostatectomy

Summary Studies detailing differences in positive surgical margin among open retropubic radical prostatectomy, laparoscopic radical prostatectomy, and robotic-assisted laparoscopic radical prostatectomy are lacking. A retrospective review of all prostatectomies with positive surgical margin performed at our center in 2007 disclosed 99 cases, 6 (5%) of which were reinterpreted cases as having negative margins. Ninety-three cases were, therefore, included, corresponding to 37 retropubic radical prostatectomies, 19 laparoscopic radical prostatectomies, and 37 robotic-assisted laparoscopic radical prostatectomies. The relationship of positive surgical margin characteristics to clinicopathologic parameters and biochemical recurrence was assessed. The most commonly found positive surgical margin site was the apex/distal third in all groups (62% retropubic prostatectomies, 79% laparoscopic prostatectomies, 60% robotic-assisted prostatectomies). Total linear length of positive surgical margin sites was significantly correlated with preoperative prostate-specific antigen, preoperative prostate-specific antigen density, pT stage, and tumor volume ($P \leq .001$). We found no significant differences among the 3 groups with respect to total linear length, number of foci, laterality, or location of positive surgical margin. The rate of biochemical recurrence was also comparable in the 3 groups. On univariate analyses, biochemical recurrence was significantly associated with preoperative prostate-specific antigen values, preoperative prostate-specific antigen density, Gleason score, number of positive surgical margins,

☆ Presented in parts at the 2009 United States and Canadian Academy of Pathology Meeting, Boston, MA, and the 2009 American Urologic Association Meeting, Orlando, FL.

☆☆ Supported by The Brady Urology Institute Prostate Cancer Patana Fund, the Koch Prostate Cancer Foundation, and the Patrick C. Walsh Prostate Cancer Research Fund.

* Corresponding author. Department of Pathology, Johns Hopkins University, Weinberg 2242, Baltimore, MD 21231, USA.
E-mail address: gnetto1@jhmi.edu (G. J. Netto).

doi:10.1016/j.humpath.2011.04.029

and total linear length of positive surgical margin ($P \leq .02$). Only preoperative prostate-specific antigen density and number of positive surgical margin foci were statistically significant ($P \leq .03$) independent predictors of biochemical recurrence. We found no significant difference in positive surgical margin characteristics or biochemical recurrence among the 3 radical prostatectomy modalities. Preoperative prostate-specific antigen density and number of positive surgical margin foci were the only independent predictors of biochemical recurrence.

1. Introduction

Positive surgical margin (PSM) on radical prostatectomy (RP) is an established independent predictor of biochemical recurrence (BCR) [1-3]. Increasingly, robotic-assisted RP (RARP) and laparoscopic RP (LRP) are pursued as minimally invasive alternatives to open retropubic RP (RRP) [4]. In addition to being dependent on operator experience, the reported rate of PSM may be related to the type of RP procedure. Generally, a 15% to 35% range of PSM has been shown in larger series of RARP, LRP, and RRP [5-11]. Whether significant differences in PSM characteristics exist among the different RP approaches is of interest, given recent reports linking histopathologic extent and location of PSM to likelihood of BCR after prostatectomy [12-15]. Only a few reports have previously compared PSM characteristics among different RP techniques [5,16,17], with only a single prior study comparing PSM among all 3 RP approaches [18]. The current study is a detailed pathologic comparison of PSM characteristics among all margin-positive RRP, LRP, and RARP specimens encountered during 1 calendar year at our hospital after adjusting for pertinent clinicopathologic parameters.

2. Materials and methods

The study was approved by the institutional review board at our hospital with Health Insurance Portability and Accountability Act compliance.

2.1. Patient cohort

During the 2007 calendar year, more than 1000 radical prostatectomies were performed at our hospitals for clinically localized prostate adenocarcinoma (PCa). A retrospective search of the institutional surgical pathology database for all RP cases pathologically reported as having PSM within the study time frame (January through December 2007) was performed. Men treated with neoadjuvant hormonal therapy and cases with incomplete preoperative records were excluded from the study. The remaining 99 patients formed the initial study population. Six cases were converted to negative surgical margins upon review and were excluded from further analysis leading to an analytic cohort of 93 patients composed of 37 RRP, 19 LRP, and 37 RARP patients. A total of 5 urologic surgeons were involved in these procedures, 4 of them performed just 1 type of procedure, whereas the last one performed RRP and RARP, predominantly the latter. No significant differences were found in the pathologic outcome according to surgical procedure and urologic surgeon involved.

2.2. Clinicopathologic parameters

Clinical and pathologic data retrieved from electronic medical records included patient's age at surgery, body mass index (BMI), pretreatment serum prostate-specific antigen (PSA) level, clinical TNM stage, prior prostate needle biopsy Gleason score (GS), and prostate gland weight. All hematoxylin and eosin sections were retrieved and reviewed by 2 urologic pathologists (G. J. N. and R. A.). PCa foci were outlined on the microscopic slides; and a mapped schema was constructed in each RP to allow reconstruction of tumor extent, tumor volume, and multifocality. RP tumor volume was calculated according to the method previously described by Chen et al [19]. GS and pathologic stage were reassessed for all RPs.

2.3. Surgical margin assessment

Formalin-fixed, paraffin-embedded prostatectomy specimens were processed using a previously described standard protocol, as detailed by Chuang and Epstein [14]. Briefly, prostates were differentially inked to indicate surgical resection margins. The proximal (bladder neck) margin was removed as a 1-mm thin shave margin. The distal 5 to 8 mm of the prostate was amputated and then sectioned parallel to the urethra in 2- to 3-mm thicknesses. After removal of the apical distal and proximal margins, the remaining prostate was sectioned at 3- to 4-mm intervals and entirely submitted for histologic examination.

Tumor presence at any inked perpendicular margins was considered a PSM. Cases in which tumor extended to the inked margins in the same plane where benign prostatic acini also extended to the inked margin were interpreted as having a positive margin due to intraprostatic incision (IPI). At the apex, presence of tumor unassociated with benign acini at or near the inked edge was considered as evidence of extraprostatic extension (EPE), with the surgical margin interpreted as positive. Tumor presence in the bladder neck