의학석사 학위논문

# Preoperative Predictors for Positive Surgical Margins and their Locations after Radical Prostatectomy in Korean men

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2013년 2월

서울대학교 대학원

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**February 2013**

**The Department of Urology,**

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**College of Medicine**

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지도 교수 정 현

이 논문을 의학석사 학위논문으로 제출함

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추 민 수

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위 원 장 _____ (인)

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# 학위논문 원문제공 서비스에 대한 동의서

본인의 학위논문에 대하여 서울대학교가 아래와 같이 학위논문 제공하는 것에 동의합니다.

1. 동의사항

① 본인의 논문을 보존이나 인터넷 등을 통한 온라인 서비스 목적으로 복제할 경우 저작물의 내용을 변경하지 않는 범위 내에서의 복제를 허용합니다.

② 본인의 논문을 디지털화하여 인터넷 등 정보통신망을 통한 논문의 일부 또는 전부의 복제.배포 및 전송 시 무료로 제공하는 것에 동의합니다.

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본 논문의 저작권을 타인에게 양도하거나 또는 출판을 허락하는 등 동의 내용을 변경하고자 할 때는 소속대학(원)에 공개의 유보 또는 해지를 즉시 통보하겠습니다.

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논문제목 : Preoperative predictors for positive surgical margins and their locations after radical prostatectomy in Korean men

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# ABSTRACT


## Introduction:

Positive surgical margins (PSMs) after radical prostatectomy (RP) are well known independent predictive risk factors of disease progression such as biochemical or local disease recurrence. In the present study, the preoperative predictors of PSMs and their locations after RP were evaluated.

## Materials and Methods:

The cases of 2404 patients who had undergone RP for clinically localized prostate cancer at three centers between 1999 and 2010, and who had not received any prior hormonal therapy, were analyzed. PSMs, defined as the presence of cancer cells at the inked margins, were categorized into four groups according to the apical, basal, posterolateral and multifocal locations.

## Results:

PSMs were observed in 802 cases (33.4%). The preoperative PSA, prostate volume and biopsy Gleason scores were significantly associated with increased PSM risk. The distribution of PSM locations

was 9.7% (234 of 2404 cases) apex, 3.3% (79) base, 9.4% (225) posterolateral (PL) and 10.9% (264) multifocal locations. The predictive variables for apical PSM were small prostate volume and positive apical biopsy. There were no statistically significant predictors for PL or basal PSM. As correlated with the type of surgery, positive apical biopsy was the predictor of apical PSM in open RP (ORP) (OR=1.7, p=0.009) and robot-assisted laparoscopic radical prostatectomy (RALP) (OR=2.2, p=0.041). Small prostate volume (less than 40ml) was the predictor of apical PSM in ORP (OR=1.6, p=0.012), but for basal PSM in RALP (OR=4.5, p<0.001). There were no statistically significant predictors for the laparoscopic RP patients.

## Conclusions:

High PSA and small prostate volume were predictive factors of PSM. Small prostate volume and positive apical biopsy were the predictive factors of apical PSM. Small prostate volume was associated with PSM at the apex in ORP, but at the base in RALP.

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**Key words:** prostatic neoplasms, prostatectomy, robotics, laparoscopy, risk factors

**Student Number:** 2011-21867

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# Introduction

Prostate cancer is the fastest growing cancer in Korea. According to National Cancer Information Center data, the incidence of prostate cancer, 8.5 per 100,000 population in 1999, had increased sharply to 23.1 by 2008, reflecting an annual rate of change of 13.5% (1). The evolution of surgical techniques and the introduction of novel surgical approaches notwithstanding, an estimated 15% of patients who undergo radical prostatectomy (RP) for clinically localized prostate cancer will have a biochemical recurrence (BCR) within five years (2).

Positive surgical margins (PSMs) after radical prostatectomy are well known independent predictive risk factors of disease progression such as biochemical recurrence or local disease recurrence (3). According to a recent study, the relative risk of recurrence in men with a PSM was 1.52 (4). However, the effect on biochemical disease-free survival was highly influenced by specific positive-margin location. The corresponding impact of apical PSM, the most common location, remains controversial, but the posterolateral (PL) site, the second most common location, correlates with the highest risk of BCR (5).

Predictors of specific location of PSM are not yet fully understood. Body mass index (BMI) was has been identified as an independent predictive factor for PSM at the apex, though it is applicable only to patients who have undergone robotic prostatectomy (6). One study

found that whereas positive apical biopsies did not predict for apical PSMs, positive basal biopsies predicted for basal PSMs (7). However, another study contradicted those results, finding no such relationship between positive-biopsy site and PSMs (8).

The present study was undertaken to investigate the preoperative predictors of PSMs and their locations after RP in a Korean population.

# MATERIALS AND METHODS

## Patient characteristics

Between January 1999 and December 2010, 2884 consecutive patients with biopsy-confirmed prostate cancer underwent radical prostatectomy (RP) at three tertiary referral centers for RP were invited to participate in the study. Nine surgeons using similar techniques provided data on a standardized spreadsheet. A total of 334 patients with clinical stage T3 or more (11.7%) were excluded from the study, as were a further 146 patients (5.2%) who had received radiotherapy and/or neoadjuvant androgen deprivation therapy prior to surgery. Among the 146 patients who received hormone therapy, 51 had clinical stage T3 or more, and 95 had clinical stage T2 or less. The remaining 2404 patients who had undergone RP at the three tertiary referral centers were included in the present analysis. Of those, 1527 patients (63.5%) underwent open radical retropubic prostatectomy (ORP), 133 (5.5%) laparoscopic radical prostatectomy (LRP), and 744 (30.9%) robot-assisted laparoscopic radical prostatectomy (RALP).

## Clinical and Pathological Parameters

After institutional review board approval, the clinical records of the

participating patients were retrospectively reviewed. The parameters for which all were evaluated were age at surgery, BMI, preoperative total prostate-specific antigen (PSA), prostate volume on preoperative trans-rectal ultrasonography (TRUS) according to the prolate ellipsoid formula (π/6 ×D3), biopsy Gleason score, clinical stage according to the 2002 American Joint Committee on Cancer (AJCC) staging system, neuro-vascular bundle (NVB) sparing technique, prostate volume of prostatectomy specimen, Gleason score for prostatectomy specimen, focal or extensive capsular invasion, perineural invasion in prostatectomy specimen, endovascular invasion in prostatectomy specimen, location of margin, margin positivity, and pathologic extension of primary tumor. All of the patients had a minimum of 6- and most had 12-to-14-core extended prostate biopsy.

## Pathologic analysis of specimens

The pathological specimens were processed similarly at the three centers. The gland weight was recorded, after which the outer surface was India-inked to delineate the surgical margins; then, the specimen was fixed in 10% neutral buffered formalin in the standard manner. Paraffin-embedded prostatectomy specimens were processed according to the whole-mount technique, stained with hematoxylin and eosin, and examined under optical microscopy. The pathologic

variables evaluated included pathologic stage, Gleason score, tumor volume, lymph node status, perineural invasion, angiolymphatic invasion, surgical margin status, extraprostatic extension, seminal vesicle invasion, and lymph node metastasis. The pathologic stage was determined according to the 2002 AJCC staging system. Extracapsular extension was defined as extension of the tumor through the prostatic capsule. PSMs, defined as cancer cells reaching the inked surface of the specimen, were categorized into four groups according to the following locations: apex, base, posterolateral, and multifocal.

## Surgical technique

ORP was performed using the anatomical approach of Walsh and Partin, as modified by each institution and/or surgeon based on experience. RALP was performed by the standard transperitoneal antegrade approach using a da Vinci® Robot Surgical system. The choice of surgical modality accorded with each patient's preference after discussion of the risks, benefits and alternatives with the attending surgeon. A unilateral or bilateral nerve-sparing procedure was performed if clinically indicated and at the discretion of each institution or surgeon, as guided by patient age, preoperative erectile function, and the oncological parameters.

## Statistical Analysis

The baseline characteristics of the patients were summarized as mean ± standard deviation (SD) for continuous variables and frequencies, or as percentages for categorical variables. Comparisons between subject groups were conducted using the Student t-test or Pearson chi-square test. The intraoperative, postoperative and pathologic variables were excluded from the analysis so as to facilitate identification of the potential preoperative predictors of PSM. These factors were established by univariate analysis, and those determined to be significant were subjected to a multivariate analysis incorporating a logistic regression model. A two-sided P value less than 0.05 was considered significant; all P values were two-sided. All of the tests were carried out with the SPSS software package (ver. 14.0, SPSS Inc., Chicago, IL, USA).

# RESULTS

## Patient characteristics

The mean patient age was 65.5±6.7 years, and the mean BMI was 24.2±2.6 kg/$m^2$. The mean PSA level was 11.3±15.2 ng/ml, and the mean prostate volume was 39.3±16.3 ml at the preoperative prostate volume; the median weight of the prostatectomy specimen was 10.7±45.4 gm. Among the patients, 1556 cases (64.7%) were clinical stage I, and 848 cases (35.3%) were stage II. The patient demographics along with the clinical and pathologic characteristics are listed in Table 1.

## Margin positive rate according the type of surgery

Positive surgical margins (PSMs) were observed in 802 cases (33.4%). As correlated with the type of surgery, the PSM rate in ORP was 32.7% (499 of 1527 cases), in LRP, 36.8% (49 of 133), and in RALP, 34.1% (254 of 744). These figures did not represent a statistically significant difference among the groups (p=0.536). Among the patients with pT2 tumors, the PSMs rates likewise did not differ statistically: ORP 19.5% (201/1031), LRP 24.5% (23/94), RALP 19.5% (92/473).

## Predictors for PSMs

In the univariate analysis considering preoperative factors only, the preoperative PSA, prostate volume, clinical stage and biopsy Gleason scores were significantly associated with increased PSM risk after RP. In the multivariate analysis, the preoperative PSA, prostate volume and biopsy Gleason scores were highly correlated with PSMs. As regards the intraoperative factors, neither the surgeon nor NVB sparing technique had any statistically significant impact on the PSM rates. As for the postoperative factors, pathologic stage and pathologic Gleason score were associated with PSMs. In the sub-group analysis according to the type of surgery, the preoperative PSA, prostate volume and biopsy Gleason scores were significant predictive variables in the ORP group, whereas in the RALP group, only preoperative PSA and prostate volume were correlates. The LRP group showed no statistically significant preoperative variables (Table. 2).

## Predictors for location of positive margin

The distribution of PSM locations was 9.7% (234 of 2404 cases) apex, 3.3% (79) base, 9.4% (225) PL and 10.9% (264) multifocal

locations. In the univariate analysis, prostate volume, biopsy Gleason score and preoperative biopsy positivity at apex were the predictive variables for apical PSMs. Prostate volume and PSA were the risk factors for basal PSM. For the PL PSM, PSA and biopsy Gleason score were significant predictors. In the multivariate analysis, positive apical biopsy and small prostate volume (less than 40 ml) were the predictors of apical PSM. There were no independent predictive factors for PL or basal PSM.

## Predictors for location of positive margin according to the type of surgery

When location was analyzed for correlation with the type of surgery, in the ORP group, 10.7% of the PSMs (164 of 1527 cases) were in the apex, 2.5% (38) in the base, 8.4% (129) in the PL, and 11.0% (168) in multifocal locations. In the LRP group, 15.7% (21 of 133 cases) of PSMs were in the apex, 2.3% (3) in the base, 8.2% (11) in the PL, and 10.5% (14) in multifocal locations. In the RALP, 6.6% (49 of 744 cases) of PSMs were in the apex, 5.1% (38) in the base, 11.4% (85) in the PL, and 11.0% (82) in multifocal locations. Apex (9.7%) and PL (9.4%) were the most common PSM locations.

In a comparative analysis for each location, PSM at apex was

observed more in patients who had undergone LRP (ORP vs. LRP vs. RALP = 10.7% vs. 15.7% vs. 6.6%, $p<0.001$); PSM at base was observed more in RALP patients (2.5 vs. 2.3 vs. 5.1, $p=0.004$); PSM at PL (8.4 vs. 8.3 vs. 11.4, $p=0.066$) and multifocal locations (11.0 vs. 10.5 vs. 11.0, $p=0.985$) showed no statistically significant differences among the three types of surgery. In the sub-group analysis according to the type of surgery, preoperative biopsy positivity at apex was the predictor of apical PSM in ORP (OR=1.7, $p=0.009$) and RALP (OR=2.2, $p=0.041$). Small prostate volume (less than 40 ml) was the predictor of apical PSM in ORP (OR=1.6, $p=0.012$), but for basal PSM in RALP (OR=4.5, $p<0.001$). There were no statistically significant predictors for the LRP patients (Table. 3).

Table 1. Patient characteristics

| | Total | ORP | RALP | LRP | p value |
|---|---|---|---|---|---|
| | 2404 | 1527 (63.5) | 744 (30.9) | 133 (5.6) | |
| **Age, yr** | 65.5 ± 6.7 | 65.6 ± 6.5 | 65.1 ± 7.0 | 66.8 ± 6.2 | 0.015* |
| **BMI, kg/m$^2$** | 24.2 ± 2.6 | 24.2 ± 2.6 | 24.5 ± 2.6 | 24.0 ± 2.2 | 0.806 |
| **PSA, ng/ml** | 11.3 ± 15.2 | 11.4 ± 14.7 | 11.2 ± 16.1 | 10.2 ± 16.3 | 0.676 |
| **Prostate volume, ml** | 39.3 ± 16.3 | 40.4 ± 17.5 | 37.2 ± 13.8 | 37.8 ± 14.1 | < 0.001* |
| **Biopsy GS, N (%)** | | | | | 0.310 |
| **≤6** | 1198 (51.5) | 744 (50.8) | 382 (52.4) | 72 (54.2) | |
| **7** | 764 (32.8) | 473 (32.3) | 246 (33.7) | 45 (33.8) | |
| **≥8** | 364 (15.7) | 147 (16.9) | 101 (13.9) | 16 (12.1) | |
| **Clinical stage N (%)** | | | | | < 0.001* |
| **cT1** | 1556 (64.7) | 968 (63.4) | 521 (70.0) | 67 (50.4) | |
| **cT2** | 848 (35.3) | 559 (36.6) | 223 (30.0) | 66 (49.6) | |
| **Pathologic stage, N (%)** | | | | | 0.143 |
| **pT2** | 1598 (66.6) | 1031 (67.7) | 473 (63.6) | 94 (70.7) | |
| **pT3a** | 575 (23.9) | 345 (22.6) | 199 (26.8) | 31 (23.3) | |
| **pT3b-4** | 226 (9.4) | 148 (9.7) | 70 (9.4) | 8 (6.0) | |
| **Pathologic GS, N (%)** | | | | | 0.057 |
| **≤6** | 709 (29.7) | 448 (29.6) | 210 (28.3) | 50 (37.6) | |

| | | | | |
|---|---|---|---|---|
| **7** | 1428 (59.7) | 899 (59.3) | 463 (62.5) | 66 (49.6) |
| **≥8** | 253 (10.6) | 169 (11.1) | 67 (9.1) | 17 (12.8) |

Table 2. Multivariate analysis of independent predictors of PSM

| | **variables** | **p value** | **comparison** | **OR** |
|---|---|---|---|---|
| **Total** | PSA | <0.001 | <4 vs 4-10 | 1.8 (1.3-2.6) |
| | | | <4 vs ≥10 | 3.9 (2.7-5.7) |
| | Prostate volume | <0.001 | <40 vs ≥40 | 1.7 (1.4-2.1) |
| | Biopsy GS | 0.012 | ≤6 vs 7 | 1.7 (1.1-1.7) |
| | | | ≤6 vs ≥8 | 1.9 (1.4-2.5) |
| **ORP** | PSA | <0.001 | <4 vs 4-10 | 1.8 (1.1-2.9) |
| | | | <4 vs ≥10 | 4.2 (2.6-6.7) |
| | Prostate volume | 0.002 | <40 vs ≥40 | 1.5 (1.2-1.9) |
| | Biopsy GS | 0.001 | ≤6 vs 7 | 1.4 (1.0-1.8) |
| | | | ≤6 vs ≥8 | 1.9 (1.4-2.7) |
| **RALP** | PSA | <0.001 | <4 vs 4-10 | 2.4 (1.3-4.4) |
| | | | <4 vs ≥10 | 5.0 (2.6-9.5) |
| | Prostate volume | <0.001 | <40 vs ≥40 | 2.6 (1.8-3.9) |
| **LRP** | none | | | |

Table 3. Multivariate analysis of independent predictors of PSM location.

| | variables | p value | comparison | OR |
|---|---|---|---|---|
| **Total** | | | | |
| **Apex** | Prostate volume | 0.010 | <40 vs ≥40 | 1.5 (1.1-2.0) |
| | Apex(+) | <0.001 | apex(+) vs apex(-) | 1.7 (1.3-2.3) |
| **ORP** | | | | |
| **Apex** | Prostate volume | 0.015 | <40 vs ≥40 | 1.6 (1.1-2.4) |
| | Apex(+) | 0.010 | apex(+) vs apex(-) | 1.7 (1.1-2.5) |
| **RALP** | | | | |
| **Apex** | Apex(+) | 0.015 | apex(+) vs apex(-) | 2.2 (1.0-4.6) |
| **Base** | Prostate volume | <0.001 | <40 vs ≥40 | 4.5 (2.0-9.7) |
| **LRP** | none | | | |

# Discussion

Precise preoperative prediction of surgical margin status and its location is of great clinical value for planning of surgical strategies and perioperative adjuvant treatments. The aim of this multi-institutional retrospective review of 11 years of Korean case data was to contribute to the present understanding of the preoperative predictors for location of PSM after RP.

## Analysis of predictors for location of margin positivity should be actively performed

PSMs after RP, still not uncommon, lead to increased risk of biochemical and local disease recurrence as well as the possibility of systemic disease progression (9). The risk of biochemical recurrence (BCR), for example, is highly influenced by the specific PSM location. Eastham et al. demonstrated that the PL site conferred the greatest probability of relapse: according to their estimated hazard ratio for progression, the PL site was 2.8, whereas the apex was only 0.94 [4]. Aydin et al. found that the risk of BCR was greater for patients with PSM at the prostate base than at other locations (10). Ohori et al. concluded that the status of the apical margin was not an independent

predictor of PSA relapse (11). The accumulative data suggest that PSM location is an important predictor of patient outcome and that accurate preoperative prediction of PSM location, correspondingly, can have important clinical implications, such as involving selection of therapeutic strategies for individual patients. In this light, analysis of preoperative predictors of margin-positivity location should be actively, even urgently pursued.

## Small prostate volume is the risk factor for PSMs

We found a significantly higher overall incidence of PSMs in patients with small prostate volumes than in those with large prostate volumes. Contrary to the belief that small prostates are easier to remove, dissection of small prostates is technically more demanding, given the wider contact area with the vascular pedicle and the less well-defined prostate-vesicle and prostate-urethral junction in those men (12). Another possibility is that men with larger prostates can harbor smaller prostate cancers, because a significant component of the elevated PSA level is due to benign hyperplasia, leading to more frequent biopsies and the identification of otherwise indolent cancer (13). Also, cancer in small prostates might be biologically different from that in large prostates, as associated with lower androgenicity. Freedland et al. reported a significant association between smaller prostates and

higher-grade and more-advanced disease, even after controlling for preoperative PSA (14).

## ORP at apex, but RALP at base

In the present study, small prostate volume was associated with a risk of apical PSM in ORP, but with a risk of basal PSM in RALP. The apex is often troublesome to expose during ORP. The confines of the pelvis and bleeding from the dorsal venous complex can hinder visualization of the apex, making it difficult to obtain generous margins (15). This could be attributed to the possibility of indistinct tissue planes surrounding small fibrous prostates (16). In RALP, with increased magnification and three-dimensional visualization, apical dissection is relatively more comfortable. The decreased blood loss owing to the tamponade effect on venous bleeding offered by the pneumoperitoneum, and to the enhanced ability to ligate the dorsal venous complex and surrounding attachment, is assumed to promote meticulous apical dissection (17). This bloodless field and improved vision enables improved apical dissection. Because prostatourethral junctions are less distinct in men with smaller prostates especially (12), it could be difficult to identify the anterior apical surface of the prostate and to ligate the dorsal venous complex under direct vision. In RALP, due to the fact that the visual factor is less relevant during basal

dissection, proper identification of the bladder neck can initially be challenging given the lack of tactile feedback in delineating the precise anatomic plane of dissection between the base of the prostate and the bladder neck (18). This also could be due to the differences between retrograde RP (open technique) and the antegrade approach (robot technique) (19).

## Apical positive on preoperative biopsy is associated with apical PSMs

Our study showed that preoperative biopsy positivity at apex was predicted for apical PSM in the ORP and RALP patients. The number of positive apical cores also is a significant predictor of apical PSMs. With each additional positive core, there is an increase in the apical-extension odds ratio of 1.32 (1.15 to 1.50, $p<0.001$) when the core number is treated as a continuous variable. Some previous studies found that a high number of positive ipsilateral cores increased the likelihood that PSM was present on that side (20, 21). As for basal PSM, however, our data showed no association with positive basal biopsy. By contrast, Borbologlu et al. found that neither positive apical nor positive basal biopsies predicted for apical or basal PSMs (8). Touma et al. reported that a positive-biopsy core at the base appears

to correlate with a basal PSM (7). We suspect that these our findings are related to the potential advantages of cancer identification of a smaller size prostates (22) and/or the distinguishing features of prostate cancer in Korean men (e.g. intrinsically poorly differentiated and more aggressive, predominantly higher-grade tumors and reduced testosterone metabolism) (23). In any case, at present there is no real explanation for such findings.

## High rate of PSMs

In the present results, the average PSM rate among the Korean men studied was 33.4%: 32.7% ORP, 36.8% LRP, and 34.1% RALP. This is comparatively high when compared with analyses involving Western subjects. Tewari et al. reported overall PSM rates worldwide as follows: 24.2% ORP, 20.4 RLP, and 16.2% RALP (24). The ethnic differences in the clinicopathologic characteristics of prostate cancer are well known (25). Song et al. reported that prostate cancer in Korean men can be more intrinsically aggressive than in Caucasian American men. Specifically, they found a significantly greater proportion of Korean men with moderate to poorly differentiated, high-Gleason-score cancer (23). Patients having a preoperative Gleason score of 8 or greater in the present study were 15.7% of the subject population, which is a significantly higher proportion than in Western countries (3.3–11.7%)

(20). Indeed, Korean men who had undergone RP presented with more advanced prostate cancer, indicating that they might be more at risk of PSMs.

## Limitation of the present study

The present study has several limitations. The main limitation is a retrospective review of our database. The choice of surgical procedure is based mainly on patient preferences about three approaches. This is a potential source of bias in this study. Additionally, as most of our patients were referred from other urologic centers, the biopsy technique was not standardized, which might help to explain the lack of correlation between some of the preoperative factors and PSM. Also our data on high volume centers with experienced surgeons might not be reflected epidemiological trends. Another concern is that we do not have central pathological review, which could lead to misclassification. Finally we do not have data on biochemical recurrence and cancer specific survival.

# Conclusion

This study demonstrates that some preoperative variables can contribute to prediction of PSM and their specific location after RP. Patients with a preoperative high PSA or a small prostate volume show a significantly higher incidence of PSMs. Positive apical biopsy was independently associated with apical PSM in patients having undergone RP. Also, patients with a small prostate volume show a significantly higher incidence of apical PSM after ORP, but of basal PSM after RALP. Such information can be useful for selection of therapeutic strategies for individual patients, for example, preoperative adjuvant therapy and/or nerve-sparing prostatectomy and modified surgical techniques.

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# 초 록


## 서론:

근치적 전립선 절제술 후 수술절제면에 남아 있는 암은 생화학적 재발의 독립적인 위험요인으로 알려져 있고, 이는 향후 추가적인 치료가 필요하게 된다. 본 연구에서는 수술절제면 양성과 그 위치를 예측할 수 있는 수술 전 인자에 대해 분석해 보고자 하였다.

## 방법:

1999년 1월부터 2010년 12월까지 3개 삼차 병원에서 임상적 국소 전립선암으로 근치적 전립선 절제술을 시행 받은 2404명을 대상으로 술 후 의무기록을 통해 후향적으로 연구하였다. 수술절제면 양성은 수술 검체의 잉크 절제면에 암세포가 존재하는 것으로 하였고, 수술절제면 양성의 위치는 첨부, 배부, 측외부, 다발성 등의 네 그룹으로 나누어 분석하였다.

## 결과:

절제면양성은 총 802명 (33.4%) 의 환자에서 관찰되었고, 절제면 양성을 예측할 수 있는 수술 전 인자로는 전립선 특이 항원, 경직장 초음파 전립선 용적, 침생검 Gleason 점수 등이 있었다. 절제면양성의 위치를 분석해 보면, 첨부는 9.7% (234명), 배부 3.3% (79명), 측외

부 9.4% (225명), 다발성 10.9% (264명) 등이었다. 첨부 절제면양성을 예측할 수 있는 수술 전 인자로는 작은 전립선 용적과 술전 침생검 상 첨부 양성 등이 통계적으로 유의하게 분석되었다. 하지만 배부, 측외부, 다발성 절제면양성을 예측할 수 있는 인자들은 찾을 수 없었다.

수술 방법 별로 나누어 하위 그룹 분석을 해보았을 때, 개복 수술 환자는 1527명 중 499명 (32.7%), 로봇 수술 환자는 744명 중 254명 (34.1%), 복강경 수술 환자는 133명 중 49명 (36.8%) 에서 절제면양성이 관찰되었다. 개복수술에서 절제면양성을 예측할 수 있는 수술 전 인자로는 전립선 특이 항원, 경직장 초음파 전립선 용적, 침생검 Gleason 점수 등이 있었고, 로봇 수술에서는 전립선 특이 항원, 경직장 초음파 전립선 용적 등이 위험인자로 분석되었다. 복강경 수술 환자에서는 의미 있는 예측 인자를 찾을 수 없었다. 수술 방법 별로 절제면양성의 위치를 예측할 수 있는 인자를 분석해 보았을 때, 개복 수술에서 첨부 절제면양성을 예측할 수 있는 수술 전 인자로는 작은 전립선 용적과 술전 침생검 상 첨부 양성 등이 통계적으로 유의하게 분석되었고, 배부, 측외부, 다발성 절제면양성의 위험인자들은 찾을 수 없었다. 로봇 수술에서는 술전 침생검 상 첨부 양성은 첨부 절제면양성을, 작은 전립선 용적은 배부 절제면양성을 예측할 수 있는 인자로 분석되었고, 측외부, 다발성 절제면양성을 예측할

수 있는 인자들은 찾을 수 없었다. 복강경 수술 환자에서는 절제면 양성 위치를 예측할 수 있는 인자를 찾을 수 없었다.

## 결론:

높은 전립선 특이 항원과 작은 전립선 용적은 근치적 전립선 절제술 후 절제면양성의 예측인자였다. 작은 전립선 용적과 술전 침생검 상 첨부 양성은 술후 첨부 절제면양성을 예측할 수 있는 독립적 예측인자로 분석되었다. 작은 전립선 용적은 개복 수술 시 첨부 절제면양성을, 로봇 수술 시 배부 절제면양성의 위험 인자로 분석되었다.

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**Key words:** 전립선암, 전립선 절제술, 로봇, 복강경, 예측 인자

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