Accuracy of computed tomography for lymph node metastasis detection in prostate cancer in Rajavithi Hospital

Pathomporn Kangsavarungkul, Chawawat Gosrisirikul, Viroj Chittchang,

Vorapot Choonhaklai, Somkiat Pumpaisanchai, Nattapong Wongwattanasatien,

Tanet Thaidumrong, Sermsin Sindhubodee, Matchima Huabkong

Division of Urology, Department of Surgery, Rajavithi Hospital, Bangkok, Thailand

Abstract

Objective: We evaluated the accuracy of CT in detecting lymph node metastasis of radical prostatectomy (RP) patients retrospectively.

Material and Method: Of a total 281 prostate cancer patients who underwent radical prostatectomy at Rajavithi Hospital from Jan 2012 to Dec 2016, 150 met the inclusion criteria. Retrospective data were analyzed to evaluate the accuracy of CT for detection of LN metastasis in prostate cancer with subgroup analysis based on the D'Amico risk classification. Statistical analyses of the data were performed using percentage, mean, mode for descriptive data and Student T-test, Mann-Whitney U test, Chi-square test and Fisher Exact test for data comparisons. Nomogram performance was assessed by AUC for the validation of Rajavithi patients about lymph node involvement (LVI).

Result: One hundred and eleven patients underwent laparoscopic radical prostatectomy (74%) and retropubic radical prostatectomy (RRP) (26%). CT scan showed a sensitivity and specificity in predicting LNI of 54.55% (6 in 11) and 94.2% (131 in 139). Subgroup analysis found that in the low-risk group (25 patients) CT scan could detect LNI in only one patient, but the pathologic finding was negative (PPV 0% and NPV 100%). The intermediate-risk group (72 patients) had PPV 25% and NPV 100% (P= 0.002), and the high-risk group (53 patients) had PPV 55.56% and NPV 88.64% (P=0.003). Statistical significance was found in the intermediate and high-risk groups. ROC curve analysis could predict LNI with CT AUC 69% and Partin table nomogram AUC 78%.

Conclusion: CT scan could detect LNI in the low-risk group but any benefit was limited. CT could provide more benefits in intermediate to high-risk prostate cancer in the detection of LN metastasis. Predictive normogram provided acceptable accuracy.

Corresponding author: Pathomporn Kangsavarungkul

Address: Division of Urology, Department of Surgery, Rajavithi Hospital, Bangkok, Thailand

E-mail: kangsa1708@gmail.com

Introduction

Prostate cancer is the most common disease in males at about 27%; it accounts for 17% of cancer and death from disease in males.[1] Lymph node metastasis is a predictor of surgical outcome. Most patients waiting for surgery have had abdominal pelvic CT for the staging and detection of lymph node metastasis. Detection of lymph node preoperative will change the management and prognosis. Curative treatment by radical prostatectomy (RP) or radical radiotherapy has no role in the optimum treatment. Sensitivity for detecting lymph node involvement varies from 8.8 to 36% with a specificity of 82-98 %. (3,12) Computed Tomography (CT) is the imaging examination commonly used in prostate cancer for staging nodal involvement. In the current guidelines, these examinations are recommended for select groups. In Thailand, there have been many cases of prostate cancer, but we wanted to evaluate the accuracy of CT in detecting lymph node metastasis in radical prostatectomy (RP) patients.

Material and method

Radical prostatectomy was performed on 281 prostate cancer patients at Rajavithi Hospital between Jan 2012 and Dec 2016. Of these patients, 150 met the inclusion criteria. Retrospective data were analyzed in order to evaluate the accuracy of CT for detection of LN metastasis in prostate cancer. Subgroup analysis was based on the D'Amico risk classification. Statistical analyses of the data were performed using percentage, mean, mode for descriptive data and the Student T-test, Mann-Whitney U test, Chi-square test and Fisher Exact test for comparisons of the data. Partin table nomogram cut point at 10% risk of lymph node metastasis to detect positives was compared with the CT assessed by AUC for validation of Rajavithi patients concerning lymph node metastasis (LNM).

Retrospectively, CT was considered positive for LNM if at least one node had a short-axis diameter of ≥10 mm, or the radiologist commented about lymphadenopathy.

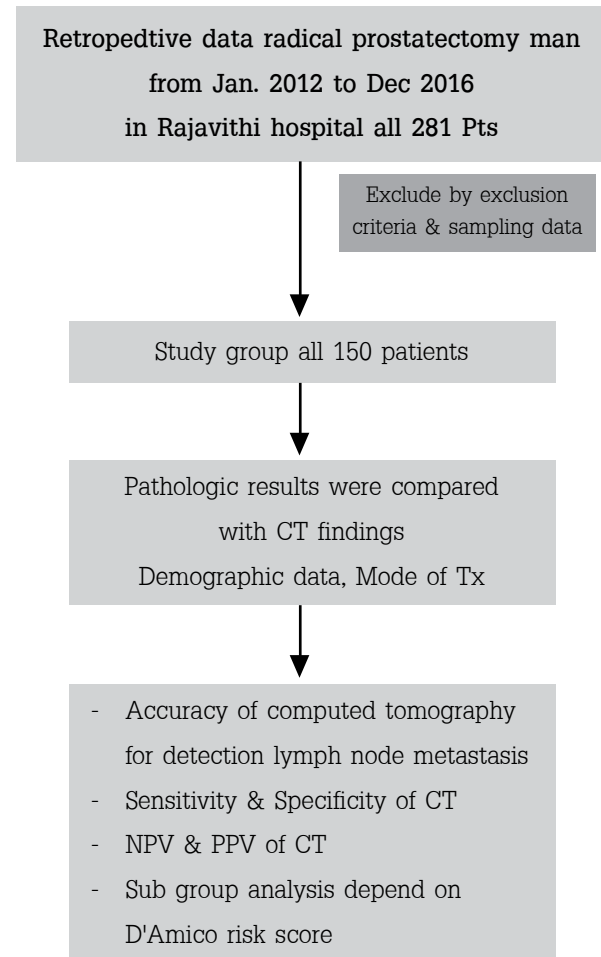Risk classification was assessed using the D'Amico risk score and reevaluated (Figure 1).

Figure 1. Diagram of methodology.

Result

The demographic data of 150 CT-staged men with prostate cancer are listed in Table 1. CT could detect lymph node metastasis overall in 14 cases. Pathologic findings were positive for metastasis in 11 cases. There were 8 cases of false positives and 5 cases of false negatives (Table 2). Sensitivity was 54.5% with a specificity of 94.2%, NPV 42.8% and PPV 96.3%.

AUC analysis of the ROC curves Patrin table was 78 % and CT was 69 % (Figure 2, 3). Sensitivity was 54% and 73% for Partin table and CT, respectively.

Table 1. Demographic data and mode of treatment classified using the D'Amico risk score.
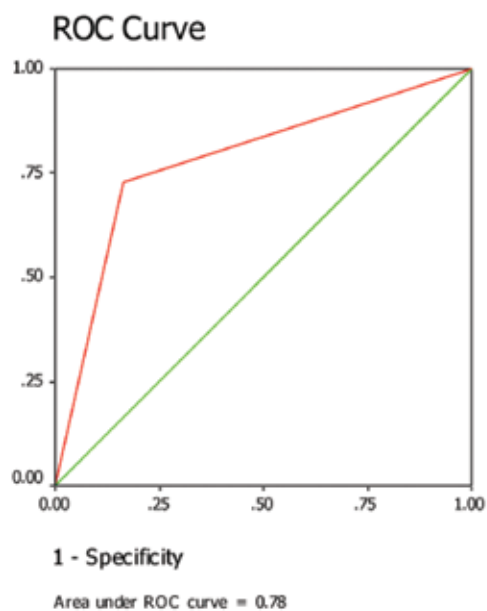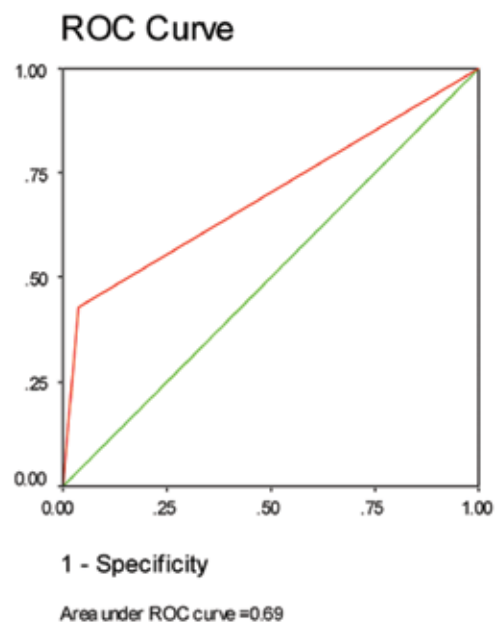
Variables	Low risk	Intermediate risk	High risk	Overall
Number of patients	25 (16.7%)	72 (48%)	53 (35.3%)	150
Mean age	65.96 ($\pm$7.77)	66.96 ($\pm$7.16)	68.13 ($\pm$7.46)	67.21 ($\pm$7.36)
Mean initial PSA (ng/ml)	7.99 ($\pm$3.35)	11.96 ($\pm$4.07)	36.38 ($\pm$31.43)	
Clinical tumor stage (%)				
cT1	17 (23.6%)	37 (51.4%)	18 (25%)	
cT2	6 (8.8%)	33 (48.5%)	29 (42.6%)	
cT3	2 (20%)	2 (20%)	6 (60%)	
Biopsy Gleason score				
Mean	6 ($\pm$0)	6.72 ($\pm$0.79)	7.25 ($\pm$1.07)	
Number of LN removed				
median	7 ($\pm$3.50)	8 ($\pm$3.56)	8 ($\pm$3.39)	8 ($\pm$3.48)
Size of prostate				
mean	45.52 ($\pm$1.20)	48.24 ($\pm$23.61)	52.94 ($\pm$22.31)	49.45 ($\pm$23.40)
CT scan finding				
Positive	1 (7.1%)	4 (28.6%)	9 (64.3%)	14
Negative	24 (17.6%)	68 (50%)	44 (32.4%)	136
size mm	0.24 ($\pm$1.20)	0.53 ($\pm$2.31)	1.72 ($\pm$4.32)	0.90 ($\pm$3.11)
Pathologic GS				
$\leq$6	8 (28.57%)	16 (57.14%)	4 (14.28%)	28
7	20 (22.72%)	46 (52.27%)	22 (25%)	88
$\geq$8	0	8 (23.52%)	26 (76.47%)	34
pN (%)				
Negative	23 (16.54%)	65 (46.76%)	51 (36.69%)	139
Positive	0	1 (9.09%)	10 (90.90%)	11
Pathologic stage				
pT2	23 (24.5%)	51 (54.3%)	20 (21.3%)	94
pT3	2 (3.6%)	21 (38.2%)	32 (58.2%)	55
pT4	0	0	1	1
Mode of Tx				
LRP	19 (17.1%)	55 (49.5%)	37 (33.33%)	111
RRP	6 (16.7%)	17 (43.6%)	16 (41.1%)	39

Table 2. CT and Lymph node pathologic results.

	Pathological of lymph node		
	Negative	Positive	Total
CT Negative	131	5	136
CT Positive	8	6	14
Total	139	11	150

Table 3. Subgroup analysis based on risk group.

	Low risk	Intermediate risk	High risk	Overall
Sensitivity	0% (0)	100% (1/1)	50.0% (5/10)	54.55% (6/11)
Specificity	96% (24/25)	95.78% (68/71)	90.70% (39/43)	94.24% (131/139)
Positive Predictive Value	0% (0/1)	25.0% (1/4)	55.56 (5/9)	42.86% (6/14)
Negative Predictive Value	100% (24/24)	100 (68/68)	88.64 (39/44)	96.32% (131/136)
Accuracy	96%	95.83%	83.00%	91.33%

ROC Curve

1 - Specificity

Area under ROC curve = 0.78

Figure 2. ROC of Partin table predict LNM.

ROC Curve

1 - Specificity

Area under ROC curve =0.69

Figure 3. ROC of CT detection of LNM.

Discussion

Risk of nodal metastasis in CAP is associated with bad clinical features and will change the treatment options. CT is widely used to determine the stage of prostate cancer.

This is my first institutional study to evaluate the accuracy of abdomino-pelvic CT to detect lymph node metastasis compared with PLND pathologic result. We found that the CT could detect LNI in 6 of 11 cases, with a sensitivity of 54.55 % and specificity of 94.2% in unclassified groups. D Gabriele et al. and Wolf: Sensitivity 8.8-34% and specificity 98%. Although some studies have shown that the sensitivity is higher than in previous studies. PPV=42.86% (6/14) was relatively low in accordance with the study by D Gabriele[3] (PPV 44.4%).

We found that CT has limitations in the use of predictive distributions to lymph nodes in prostate cancer, which correspond with many guidelines. Thus, our subgroup analysis found that in the low-risk group CT could detect only one LVI, but no pathological LVI results.

In the intermediate group, there were 4 cases of LVI but the pathologic result was positive in only 1 case. Sensitivity was 100% (PPV 25%). But in high-risk groups we found that CT LVI sensitivity was 50% (PPV 55.56%). Significant differences were found in the intermediate group and the high-risk group. In addition, in the low and intermediate-risk patients NPV = 100 may not be required for PLND, if CT does not detect LNM in this patient group.

The LVIs found in prostate cancer are most commonly used by short-range 8-10 mm criteria, which are about 36-40% sensitive, but can be increased by decreasing the threshold to 6 mm. Cutting at 10 mm causes the sensitivity of this research to be relatively low.

In our study, we used the Partin table normogram to detect LNM with sensitivity = 72.73% and specificity = 83.45%, which is higher than CT for LNM.

PPV is about 25% lower with Partin table normogram because prevalence of LNM in prostate cancer is low, 5-12% of prostate cancer patients. Acceptance of the Partin table normogram in Rajavithi Hospital can be confirmed by ROC 78% compared with CT 69%.

The main limitation of this study was the heterogeneousness of the cohort and the retrospective nature of our data. Furthermore, staging imaging procedures were performed by different physicians.

Conclusion

CT scan could detect LNI in low-risk groups but any benefit was limited. We conclude that CT could provide more benefits in intermediate to high-risk prostate cancer in the detection of LN metastasis. Accuracy of predictive normogram could be acceptable.

Conflict of interest

The authors declare no conflict of interest.

References

1. Siegel R, Ma J, Zou Z, Jemal A. Cancer statistics. CA Cancer J Clin 2014;64:9-29.

2. ธนพล ทนคำดี. รายงานสถิติโรคมะเร็งประจำปี หน่วยทะเบียนมะเร็ง คณะแพทยศาสตร์รามาธิบดี (พ.ศ 2553-2557).

3. Gabriele D, Collura D, Oderda M, Stura I, Fiorito C, Porpiglia F, et al. Is there still a role for computed tomography and bone scintigraphy in prostate cancer staging? An analysis from the EUREKA-1 database. World J Urol 2016;34: 517-23.

4. Dong F, Attan MW, Steyerberg EW, Jones JS, Stephenson AJ, Schröder FH, et al. Validation of pretreatment nomograms for predicting indolent prostate cancer: Efficacy in contemporary urological practice. J Urol 2008;180: 150-4.

5. Hansen J, Becker A, Kluth LA, Rink M, Steuber T, Zacharias M, et al. Assessing the clinical benefit of a nomogram to predict specimen-confined disease at radical prostatectomy in patients with high-risk prostate cancer: An external validation. Urol Oncol 2015;33:384.e1-8.

6. Gupta RT, Brown AF, Silverman RK, Tay KJ, Madden JF, George DJ, et al. Can radiologic staging with multiparametric MRI enhance the accuracy of the Partin Tables in predicting organ-confined prostate cancer? AJR Am J Roentgenol 2016;207:87-95.

7. Moschini M, Sharma V, Zattoni F, Boorjian SA, Frank I, Gettman M T, et al. Risk stratification of pND prostate cancer after radical prostatectomy from a large single institutional series with long-term followup. J Urol 2016;1773-8.

8. Abdollah F, Cozzarini C, Sun M, Suardi N, Gallina A, Passoni NM, et al. Assessing the most accurate formula to predict the risk of lymph node metastases from prostate cancer in contemporary patients treated with radical prostatectomy and extended pelvic lymph node dissection. Radiother Oncol 2013;109:211-6.

9. Briganti A, Blute ML, Eastham JH, Graefen M, Heidenreich A, Karnes JR, et al. Pelvic lymph node dissection in prostate cancer. Eur Urol 2009;55:1251-65.

10. Naito S, Kuroiwa K, Kinukawa N, Goto K, Koga H, Ogawa O, et al. Validation of Partin tables and development of a preoperative nomogram for Japanese patients with clinically localized prostate cancer using 2005 International Society of Urological Pathology consensus on Gleason grading: Data from the Clinicopathological Research Group for Localized Prostate Cancer. J Urol 2008;180:904-9; discussion 909-910.

11. Deserno WM, Debats OA, Rozema T, Fortuin AS, Heesakkers RA, Hoogeveen Y, et al. Comparison of nodal risk formula and MR lymphography for predicting lymph node involvement in prostate cancer. Int J Radiat Oncol Biol Phys 2011;81:8-15.

12. Heesakkers RA, Hövels AM, Jager GJ, van den Bosch HC, Witjes JA, RaatHP, et al. MRI with a lymph-node-specific contrast agent as an alternative to CT scan and lymph-node dissection in patients with prostate cancer: A prospective multicohort study. Lancet Oncol 2008;9:850-6.

13. Oyen RH, Van Poppel HP, Ameye FE, Van de Voorde WA, Baert AL, Baert LV et al. Lymph node staging of localized prostatic carcinoma with CT and CT-guided fine-needle aspiration biopsy: prospective study of 285 patients. Radiology 1994;190:315-22.