Use of CT to Reduce Understaging in Prostatic Cancer: Comparison with Conventional Staging Techniques

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Thirty prostatic cancer patients were evaluated for staging purposes with both CT (18-sec scan speed) and certain commonly used "conventional" diagnostic tests, namely: radionuclide bone scan with correlative plain films, the prostatic fraction of the serum acid phosphatase, excretory urogram, and chest radiograph. All patients included in the study had histopathologic proof of diagnosis. CT correctly identified extracapsular prostatic cancer spread locally or in pelvic lymph nodes in 14% of patients with completely negative conventional studies. Sensitivity of extracapsular tumor spread detection increased from 41% to 59% by adding CT to the conventional studies. CT confirmed the presence of tumor spread and localized it in 43% of patients with positive conventional studies. Conventional studies were positive when tumor spread was present in 32% of patients with negative CT. CT reduces understaging when conventional tests are negative, localizes and confirms tumor spread when conventional tests are positive, but cannot demonstrate tumor spread in some patients whose conventional tests are positive and who are subsequently shown to have tumor spread histopathologically.

Conventional noninvasive diagnostic techniques used for staging prostatic cancer often cannot show the full extent of the disease. For example, digital rectal examination has been reported to underestimate local spread in 25%–45% of cases [1, 2]. Serum acid phosphatase level was found normal in 24% of patients with metastases to bone [3]. Seminal vesicle invasion has been reported in 6%–25% of patients in whom it was not detected clinically [4–6]. Metastases to the regional lymphatics are often present at surgery when the radionuclide bone scan is negative and clinically the patient has a localized stage of the disease [7, 8].

Lymphangiography can detect lymph node metastases and has a reported accuracy of 48%–79% [9–11]. Pelvic lymphadenectomy also can detect lymph node metastases and is very accurate but invasive, with significant morbidity and even a death reported with its use [12].

These considerations make the development of noninvasive staging techniques desirable. Early studies suggested the utility of CT for this purpose [13] and several subsequent studies showed that CT could detect pelvic lymph node metastases [11–19] and local extension [19] in prostatic cancer. However, CT has not yet been compared to conventional staging techniques. Our study was designed to compare CT with conventional techniques to see if useful staging information could be obtained from CT that was not available from the conventional studies.

Subject and Methods

Over a 32-month period, 64 patients with the diagnosis of prostatic cancer had CT scans of the pelvis. All patients had the diagnosis of the primary tumor confirmed by microscopic examination of tissue obtained by transrectal or transperineal needle biopsy or by transu-

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rethral resection before evaluation by CT. All patients had been evaluated with conventional noninvasive diagnostic techniques consisting of chest radiograph, assay for the prostatic fraction of the serum acid phosphatase, radionuclide bone scans with correlative plain-film skeletal surveys, and excretory urograms. Histopathologic data were obtained for comparison with the CT findings within 90 days after the scan in 30 patients. This biopsy material was obtained by pelvic lymphadenectomy in eight patients, radical prostatectomy (i.e., prostatovesiculectomy and pelvic lymphadenectomy) in 18, percutaneous needle biopsy of enlarged lymph nodes in two, autopsy in one, and cystoscopy in one. Only these patients, with histopathologic proof of the CT diagnosis, constitute the basis of the results reported here.

CT scans were done with the Pfizer 0200 FS scanner; the scan duration was 18–26 sec with images displayed on a 256 × 256 matrix and recorded on magnetic tape and film. Scans were performed at 1.5 cm intervals from the iliac crest to the symphysis pubis. Most patients received intravenous (50 ml of 50% diatrizoate sodium in isotonic saline) and oral (900 ml of 1.2% barium sulfate) contrast medium and 1 mg of intravenous glucagon.

The criteria for the diagnosis of prostatic cancer metastatic to pelvic lymph nodes were adapted from Walsh et al. [14]. This consisted of finding masses discrete from the primary tumor of 2 cm or larger, which are often first apparent as asymmetry of the pelvic vascular bundles (fig. 1). Criteria for the diagnosis of local extracapsular extension were adapted from Seidelman et al. [20] and Bonney et al. [21]. These consisted of obliteration of the seminal vesicle angle and/or the appearance of invasion of the bladder or surrounding structures (fig. 2), while being aware that benign prostatic hypertrophy can cause irregularity of the posterior bladder wall. CT results used in this study were obtained by reviewing all scans and making the diagnosis of lymph node metastases or local extracapsular extension by these criteria without the knowledge of the pathologic diagnosis.

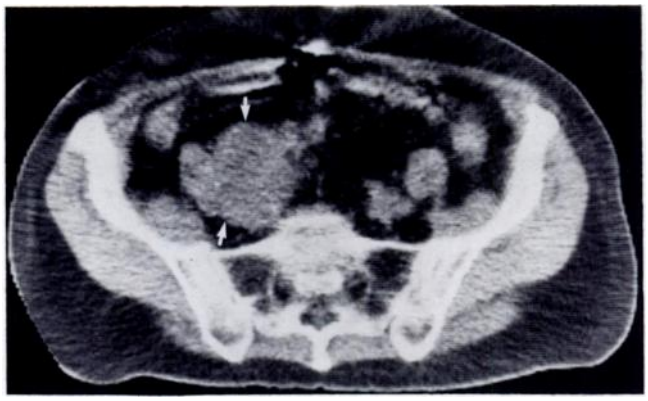

Fig. 1.—Asymmetry in vascular bundles in prostatic cancer patient due to large lymph node metastasis (*arrows*) near right common iliac artery and vein.

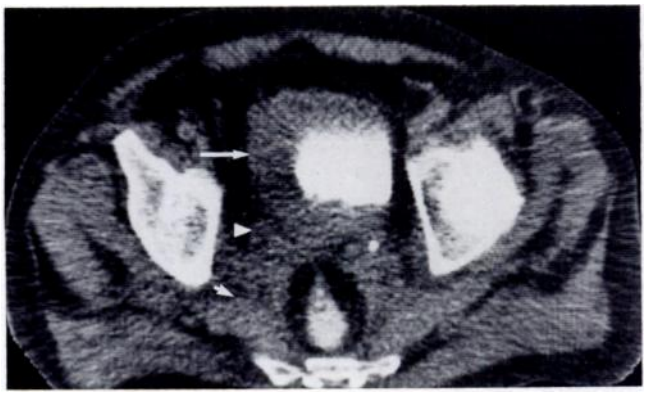

Fig. 2.—Loss of normal seminal vesicle outlines, filling in of seminal vesicle angles (*arrowhead*), displacement of contrast from right side of bladder (*long arrow*), and increased soft-tissue density in perirectal spaces (*short arrow*), all from local extension of prostatic cancer.

Results

Sensitivities, specificities, and accuracies of CT in detection of spread of prostatic cancer checked histopathologically are shown in table 1. Computed tomography had low sensitivities in this group of patients for the detection of both local spread and pelvic lymph node metastases. The specificities were high: 92% or greater for all forms of tumor spread within the pelvis. The accuracies of CT were 67% for lymph node metastases, 73% for local extension, and 69% for all extracapsular spread.

Comparisons of CT with conventional noninvasive diagnostic techniques in the detection of extracapsular tumor (either local or metastatic) are shown in table 2. Of the patients with negative conventional workups, 14% had extracapsular tumor that was detected by CT. However, conventional studies were able to detect histopathologically proven tumor in 32% of patients with negative CT findings. Sensitivity in detecting extracapsular tumor spread was increased from 41% by conventional methods to 59% when CT was added. CT confirmed the presence of tumor spread in 43% of those patients with tumor detected by conventional techniques and located the site of spread in these patients.

Discussion

Staging prostatic cancer, by detection of local extent and distant spread, and histologic grading form the bases of rational treatment and estimation of prognosis. CT has been evaluated previously as an isolated tool that can detect the spread of prostatic cancer [14–19]. However, its usefulness in adding information that cannot be obtained by conventional tests commonly in use has not been evaluated before. We found that CT was able to detect extracapsular tumor spread in 14% of patients whose conventional tests were completely negative, and CT increased the sensitivity of tumor spread detection from 41% to 59% when added to the conventional tests. These results demonstrate that CT can detect extracapsular spread of prostatic cancer as well as the earlier studies, but also can do so when the conventional staging studies are negative for tumor spread.

CT is also helpful when the conventional tests are positive, since in many instances, the question of whether they are falsely positive exists, and the site of tumor spread is not identified. CT was positive in 43% of patients with positive conventional studies. With the high specificity of CT in our study and others [14–19], the combination of positive CT findings with positive conventional studies indicates with a high degree of certainty that extracapsular tumor spread

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TABLE 1: **Sensitivity, Specificity, and Accuracy of CT in Detecting Extracapsular Spread of Prostatic Cancer**

CT	Sensitivity* (%)	Specificity† (%)	Accuracy‡ (%)
Nodal metastases	25 (3/12)	100 (15/15)	67 (18/27)
Local extension	50 (5/10)	92 (11/12)	73 (16/22)
Either or both	36 (8/22)	97 (26/27)	69 (34/49)

Note.—Standard is histopathologic examination.
* Numerator = true positives; denominator = true positives + false negatives.
† Numerator = true negatives; denominator = true negatives + false positives.
‡ Accuracy is the proportion of histopathologically correct CT predictions to total CT predictions.

TABLE 2: **Comparison of CT with Conventional Staging Techniques for Detection of Prostatic Cancer Spread**

	No. Patients (%)
Detection of spread by CT but not by conventional methods	3/22 (14)
Detection of spread by conventional methods but not by CT	7/22 (32)
Sensitivity of conventional methods	7/17 (41)
Sensitivity of conventional methods together with CT	10/17 (59)
Localization by CT when conventional methods positive	3/7 (43)

Note.—Conventional studies consisted of radionuclide bone scan with correlative plain films, excretory urogram, serum acid phosphatase and its prostatic fraction, and chest radiograph. Spread was considered present if tumor was found outside the prostatic capsule either locally or metastatic.

exists. CT identifies its location, which makes it possible to obtain histologic proof by percutaneous needle biopsy.

In our study, 32% of patients with negative CT had positive conventional studies and had tumor spread. Therefore, at least with our equipment, CT does not replace the conventional tests. While it might be expected that the new, faster CT scanners with better resolution will detect an even larger number of patients with tumor spread and negative conventional studies, it is unlikely that they will completely replace conventional studies, especially the radionuclide bone scan, in the near future.

Sensitivity of detection of lymph node metastases in prostatic cancer reported in the literature has varied from 17% to 100% [14–19]. While small numbers of subjects probably accounts for some of the range of sensitivities reported, a more important variable is how advanced the disease is when the patient is scanned. Sensitivity of CT would be expected to be high in patients with advanced metastatic disease shown by other means including the conventional diagnostic studies. However, little useful staging information can be gained by CT in this group of patients. Comparison of CT with conventional methods shows not only what CT can add to those already established diagnostic staging studies, but also shows how advanced the spread of prostatic cancer was when the patient was evaluated by CT. For example, in our group of patients, 22 of 30 had conventional diagnostic staging studies that were completely negative. This group of patients did not have advanced metastatic disease. Detection of local or metastatic extracapsular tumor in this group of patients by CT was much more useful clinically than detection of tumor spread by CT in a patient population with known metastatic disease.

The diagnosis of lymph node metastases by CT is made by imaging enlarged lymph nodes. Specificities so far attained attest to the fact that in the patient with prostatic cancer, it is very unusual for enlarged lymph nodes to be due to anything except prostatic cancer metastases [14–19]. Needle biopsy can be used to obtain a histologic diagnosis [22, 23] and will probably do so with less morbidity than pelvic lymphadenectomy. On the other hand, a negative CT scan does not exclude early metastatic spread that has not yet enlarged the lymph nodes sufficiently to be detected by CT.

Our results on the sensitivity, specificity, and accuracy of detecting local extracapsular extension of prostatic cancer with CT are similar to those previously published [19]. The finding of local tumor extension may have value in predicting which patients have occult metastatic disease. Also, the surgeon who attempts cure by local resection will be guided by the CT scan.

In conclusion, CT has been compared to some of the more commonly used "conventional" studies for staging prostatic cancer. The addition of CT to the conventional studies reduces understaging when the conventional studies are negative. CT confirms the presence of and localizes tumor spread when the conventional studies are positive. CT currently does not replace the conventional studies for staging prostatic cancer, but can complement them, especially in patients without advanced metastatic disease.

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