

**DIAGNOSTIC ULTRASOUND
OF THE PROSTATE**

Diagnostic Ultrasound of the Prostate

Proceedings of the First International Workshop on Diagnostic Ultrasound of the Prostate, held October 22 through 23, 1988, in Washington, D.C.

Editors:

Martin Resnick, MD

Professor and Chairman

Division of Urology

Case Western University, School of Medicine

Cleveland, Ohio

Hiroki Watanabe, MD

Professor and Chairman

Division of Urology

Kyoto Prefectural University of Medicine

Kyoto, Japan

James P. Karr, PhD

Organ Systems Coordinating Center

Roswell Park Memorial Institute

Buffalo, New York



Elsevier

New York • Amsterdam • London

No responsibility is assumed by the Publisher for any injury and/or damage to persons or property as a matter of products liability, negligence, or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein. No suggested test or procedure should be carried out unless, in the reader's judgment, its risk is justified. Because of rapid advances in the medical sciences, we recommend that the independent verification of diagnoses and drug dosages should be made. Discussions, views, and recommendations as to medical procedures, choice of drugs, and drug dosages are the responsibility of the authors.

Elsevier Science Publishing Co., Inc.
655 Avenue of the Americas, New York, New York 10010

Sole distributors outside the United States and Canada:
Elsevier Science Publishers B.V.
P.O. Box 211, 1000 AE Amsterdam, The Netherlands

© 1989 by Elsevier Science Publishing Co., Inc.

This book has been registered with the Copyright Clearance Center, Inc.
For further information please contact the Copyright Clearance Center, Inc.,
Salem, Massachusetts.

This book is printed on acid-free paper.

Library of Congress Cataloging-in-Publication Data

Diagnostic ultrasound of the prostate / editors, Martin Resnick,
Hiroki Watanabe, James P. Karr.
p. cm.

Contains papers presented at the First International Workshop on
Diagnostic Ultrasound of the Prostate, held in Washington, D.C.,
Oct. 22-23, 1988, sponsored by the National Science Foundation, Organ Systems
Coordinating Center of the National Cancer Institute's Organ Systems Program,
and the Japanese Society for the Promotion of Sciences.

1. Prostate — Ultrasonic imaging — Congresses. 2. Prostate — Cancer-
-Diagnosis — Congresses. I. Resnick, Martin I. II. Watanabe,
Hiroki, 1935- . III. Karr, James P. IV. International Workshop
on Diagnostic Ultrasound of the Prostate (1st : 1989 : Washington,
D.C.) V. National Science Foundation (U.S.) VI. Organ Systems Coordinating
Center (National Cancer Institute) VII. Nihon Gakujutsu Shinkōkai.

[DNLM: 1. Prostatic Neoplasms — diagnosis — congresses.
2. Prostatic Neoplasms — therapy — congresses. 3. Ultrasonic
Diagnosis — congresses. WJ 752 D5355 1988]

RC280.P7D53 1989
616.99'46307543 — dc20
DNLM/DLC
for Library of Congress

89-23298
CIP

ISBN 0-444-01489-6

Current printing (last digit):

10 9 8 7 6 5 4 3 2 1

Manufactured in the United States of America

PREFACE

In July, 1979, an International Workshop on Diagnostic Ultrasound in Urology and Nephrology was held in Kyoto, Japan. Recognized investigators from over ten countries contributed to this very successful and informative meeting, the proceedings of which were published in 1981 in a monograph entitled, "Diagnostic Ultrasound in Urology and Nephrology" and edited by Hiroki Watanabe, Joseph H. Holms, Hans H. Holm and Berry B. Goldberg. Technical and clinical aspects of the field have continued to evolve over the past eight years and because of the rapid changes related to the clinical applications of ultrasonography, and particularly prostatic ultrasonography, it was believed that a meeting devoted specifically to this latter topic would be timely and of great value.

The First International Workshop on Diagnostic Ultrasound of the Prostate was held on October 22-23, 1988, and the organizers coordinated the meeting with the 1988 World Federation for Ultrasound in Medicine and Biology which met the week before in Washington, DC. Participants of the workshop included distinguished investigators from Europe, Japan and the United States who represented various disciplines including urology, radiology and pathology.

Because of the rapid changes and developments in transrectal ultrasonography three major categories were reviewed. These were the role of prostate ultrasonography in early diagnosis and screening for carcinoma of the prostate, the value of transrectal ultrasonography in tumor staging, and the use of transrectal ultrasonography in monitoring response to therapy. In addition to multiple presentations related specifically to transrectal prostatic ultrasonography, much discussion was also devoted to the value of other imaging (computerized tomography, magnetic resonance imaging) and laboratory (prostatic specific antigen, prostatic acid phosphatase) studies. Fruitful discussions were held following these presentations and all have been included in this monograph.

The editors would like to express their appreciation to the many investigators who contributed to the success of the meeting and this monograph. Additionally, the support of sponsoring organizations (National Science Foundation, Organ Systems Coordinating Center of the National Cancer Institute's Organ Systems Program, and the Japanese Society for the Promotion of Sciences) is highly valued and without their active involvement this meeting would not have been possible. This undertaking which has involved so many individuals from different countries and of different backgrounds, has truly been a cooperative effort. For those attending the meeting and those reading the monograph, the importance of this interaction is evident.

M. Resnick
H. Watanabe
J. Karr

CONTRIBUTORS LIST

Masayoshi Akisada, M.D.
Department of Radiology
Institute of Clinical Medicine
University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi
Ibaraki, 305, JAPAN

Takahiro Akiyama, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Gerald Andriole, M.D.
Division of Urologic Surgery
Washington University School of Medicine
216 Wohl Hospital
4960 Audubon Avenue
St. Louis, MO 63111

Yoshio Aso, M.D.
Faculty of Medicine
University of Tokyo
Tokyo, JAPAN

Richard J. Babaian, M.D.
Department of Urology
M.D. Anderson Hospital and Tumor Institute
6723 Bertner Avenue
Houston, TX 77030

Frans M.J. Bentvelsen, M.D.
Department of Urology
Erasmus University Rotterdam
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

Michael Brawer, M.D.
Department of Urology, RL-10
University of Washington
1959 Pacific Street, N.E.
Seattle, WA 98195

Paul J. Carpentier, M.D.
Department of Urology
Erasmus University Rotterdam
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

Peter Carroll, M.D.
Departments of Radiology and Urology
University of California San Francisco
San Francisco, CA 94143

Simon St. Clair Carter, M.D.
Institute of Urology
London, ENGLAND

William J. Catalona, M.D.
Division of Urologic Surgery
Washington University School of Medicine
216 Wohl Hospital
4960 Audubon Avenue
St. Louis, MO 63110

Andrew Chiarodo, Ph.D.
Chief, Organ Systems Program
CCB DCPC National Cancer Institute
Blair Building Room 717
9000 Rockville Pike
Bethesda, MD 20892-4200

Gerald Chodak, M.D.
Department of Surgery
Section of Urology
Box 403
University of Chicago
5841 South Maryland Avenue
Chicago, IL 60637

Wolfgang Dahnert, M.D.
Thomas Jefferson University
School of Medicine
11th & Walnut Streets
Philadelphia, PA 19107

Nancy Dragone, R.N.
Department of Urologic Oncology
Roswell Park Memorial Institute
666 Elm Street
Buffalo, NY 14263

Awato Fujino, M.D.
Department of Urology
Kitasato University
School of Medicine
1-15-1, Kitasato, Sagamiharashi
Kanagawa, 228, JAPAN

Maarten Gali  , M.D.
Department of Urology
Erasmus University
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

Gedes Grinis, M.D.
Divisions of Nuclear Medicine and Urology
Cook County Hospital
1825 West Harrison
Chicago, IL 60612

Patrick Guinan, M.D.
Divisions of Nuclear Medicine and Urology
Cook County Hospital
1825 West Harrison
Chicago, IL 60612

Masaoki Harada, M.D.
Laboratory of Pathology
Kanagawa Cancer Center Clinical
Research Institute
54-2 Nakao-cho, Asahi-ku, Yokohama
Kanagawa, JAPAN, 241

Tetsuya Hashimoto, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamikyo-ku
Kyoto 602, JAPAN

Yoshio Higaki, M.D.
Department of Urology
Showa University School of Medicine
1-5-8 Hatanodai, Shinagawa-ku
Tokyo, 142, JAPAN

Hedvig Hricak, M.D.
Departments of Radiology and Urology
University of California, San Francisco
San Francisco, CA 94143

Robert Huben, M.D.
Department of Urologic Oncology
Roswell Park Memorial Institute
666 Elm Street
Buffalo, NY 14263

Kazuo Imamura, M.D.
Department of Urology
Showa University School of Medicine
1-5-8, Hatanodai, Shinagawa-ku
Tokyo, 142, JAPAN

Akira Ishibashi, M.D.
Department of Urology
School of Medicine
Kitasato University
1-15-1, Kitasato, Sagamiharashi
Kanagawa, 228, JAPAN

Harold Jansen, M.D.
Department of Urology
Erasmus University
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

James P. Karr, Ph.D.
Organ Systems Coordinating Center
Roswell Park Memorial Institute
666 Elm Street
Buffalo NY 14263

Ryuichi Kitagawa, M.D.
Department of Urology
Juntendo University School of Medicine
Tokyo, JAPAN

Hiroyuki Kobayashi, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamikyo-ku
Kyoto 602, JAPAN

Kenjiro Kohri, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Kenkichi Koiso, M.D.
Departments of Urology and Radiology
Institute of Clinical Medicine
University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi
Ibaraki, 305, JAPAN

Munekado Kojima, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji
Kyoto, JAPAN

Ken Koshiba, M.D.
Department of Urology
School of Medicine
Kitasato University
1-15-1, Kitasato, Sagamiharashi
Kanagawa, 228, JAPAN

Seiji Kunikata, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Takashi Kurita, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Paul Lange, M.D.
Department of Urology
University of Washington
1959 Pacific Street, N.E.
Seattle, WA 98195

Fred Lee, M.D.
St. Joseph Mercy Hospital
Ultrasound Department
5301 East Huron River Drive
P.O. Box 995
Ann Arbor MI 48106

Joseph LiPuma, M.D.
Department of Radiology
Western Reserve University
University Hospitals of Cleveland
2065 Adelbert Road
Cleveland OH 44106

Vincent Lopez-Majano, M.D.
Divisions of Nuclear Medicine and Urology
Cook County Hospital
1825 West Harrison
Chicago, IL 60612

John Maksem, M.D.
Director of Laboratory
Department of Pathology
Mercy Hospital Medical Center
6th and University
Des Moines, IA 50314

Petar A. Maksimovic, M.D.
Department of Urology
Erasmus University Rotterdam
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

Naoto Miyanaga, M.D.
Department of Urology and Radiology
Institute of Clinical Medicine
University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi
Ibaraki, 305, JAPAN

Hiroaki Miyashita, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamigyo-ku
Kyoto, JAPAN 602

Shohei Nakamura, M.D.
Faculty of Medicine
University of Tokyo
Tokyo, JAPAN

Ryosuke Nemoto, M.D.
Department of Urology and Radiology
Institute of Clinical Medicine
University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi
Ibaraki, 305, JAPAN

Yukiko Nishijima, M.D.
Department of Urology
Institute of Clinical Medicine
University of Tsukuba
1-1-1 Tennodai, Tsukuba-shi
Ibaraki, 305, JAPAN

Hiroshi Ohe, M.D.
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji
Kyoto, JAPAN

Kiyoki Okada, M.D.
Nikon University
School of Medicine
Tokyo, JAPAN

Young-Chol Park, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Howard Pollack, M.D.
University of Pennsylvania
School of Medicine
34th & Spruce Streets
Philadelphia, PA 19104

Martin Resnick, M.D.
Division of Urology
Case Western Reserve University
University Hospitals of Cleveland
2065 Adelbert Road
Cleveland, OH 44106

Matthew D. Rifkin, M.D.
Professor of Radiology & Urology
Jefferson Medical College
Thomas Jefferson University Hospital
Philadelphia, PA 19107

Marvin Rubenstein, Ph.D.
Rush-Presbyterian
St. Lukes Medical Center
1753 W. Congress Pkwy
Chicago, IL 60612

Toshihiko Saito, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamikyo-ku
Kyoto 602, JAPAN

Masahito Saitoh, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamikyo-ku
Kyoto 602, JAPAN

Toyohiko Saitoh, M.D.
The Department of Urology
Showa University School of Medicine
1-5-8 Hatanodai, Shinagawa-ku
Tokyo, 142, JAPAN

Pratiba Sansi, M.D.
Divisions of Nuclear Medicine and Urology
Cook County Hospital
1825 West Harrison
Chicago, IL 60612

Peter Scardino, M.D.
Baylor College of Medicine
Scurlock Tower
6560 Fannin
Suite 1003
Houston TX 77030

Fritz Schroder, M.D.
Department of Urology
Erasmus University
P.O. Box 1738
3000 DR Rotterdam
THE NETHERLANDS

Douglas B. Siders, M.D.
Department of Pathology
St. Joseph Mercy Hospital
5301 East Huron River Drive
Ann Arbor, MI 48106

Joseph A. Smith, Jr., M.D.
Department of Surgery/Urology
University of Utah Medical Center
50 North Medical Drive
Salt Lake City UT 84132

Yoshiki Sugiyama, M.D.
Department of Urology
Juntendo University School of Medicine
3-3-3 Hongo, Bunkyo-ku
Tokyo, 113, JAPAN

Masahiko Takada, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Yoshikatsu Tanahashi, M.D.
Tohoku University School of Medicine
Sendai, JAPAN

Kazuyuki Tazaswa, M.D.
Department of Urology
Showa University School of Medicine
1-5-8 Hatanodai, Shinagawa-ku
Tokyo, 142, JAPAN

Soren T. Torp-Pedersen, M.D.
Departments of Radiology and Ultrasound
Herlev Hospital
University of Copenhagen
Copenhagen, DENMARK

Hironori Tsujihashi, M.D.
Department of Urology
Kinki University School of Medicine
377-2 Ohno-Higashi, Osaka-Sayama
Osaka, 589, JAPAN

Hiroki Watanabe, M.D.
Department of Urology
Kyoto Prefectural University of Medicine
Kawaramachi-Hirokoji, Kamigyo-ku
Kyoto, 602, JAPAN

Richard Wolf, M.D.
Department of Urologic Oncology
Roswell Park Memorial Institute
666 Elm Street
Buffalo, NY 14263

Hideki Yoshida, M.D.
Department of Urology
Showa University School of Medicine
1-5-8 Hatanodai
Shinagawa-ku
Tokyo, 142, JAPAN

CONTENTS

Preface	ix
Contributors	xi
PROCEEDINGS OF THE FIRST INTERNATIONAL WORKSHOP ON DIAGNOSTIC ULTRASOUND OF THE PROSTATE	
STAGING	
Organ Systems Program Staging Classification for Prostate Cancer <i>Willet F. Whitmore, Jr., William J. Catalona, John T. Grayhack, Gerald Hanks, Paul C. Peters, William U. Shipley, Patrick C. Walsh, Donald S. Coffey, F. Andrew Door, James P. Karr and Martin I. Resnick</i>	1
The Japanese Staging System <i>Hiroki Watanabe</i>	4
<u>Staging with Ultrasound</u>	
The Diagnosis and Staging of Prostate Cancer Using Transrectal Ultrasound <i>Fred Lee, Soren T. Torp-Pedersen and Douglas B. Siders</i>	13
Transrectal Linear and Transperineal Convex Scanning for Staging Prostatic Cancer: An Aid for Ultrasound Guided Biopsy <i>Yoshikatsu Tanahashi</i>	22
Transrectal Ultrasonography in the Staging of Prostate Cancer <i>Gerald L. Andriole and William J. Catalona</i>	25
Ultrasonography in the Evaluation of Cancer of the Prostate <i>Kenkichi Koiso, Ryosuke Nemoto, Yukiko Nishijima, Naoto Miyanaga and Masayoshi Akisada</i>	31
Ultrasound Staging of Prostatic Cancer According to Cancer Volume <i>Yoshiki Sugiyama and Ryuichi Kitagawa</i>	36
Detection of Cancer Invasion into the Seminal Vesicles by Ultrasound and Puncture <i>Tetsuya Hashimoto, Toshihiko Saito, Hiroyuki Saito, Hiroyuki Kobayashi, Masahito Saitoh and Hiroki Watanabe</i>	41
<u>Comparison/Correlation of Ultrasound with Other Staging Modalities</u>	
Prostatic Cancer Staging by Ultrasound and Digital Examination <i>Yoshio Aso</i>	48
Ultrasound Staging for Prostatic Carcinoma with Correlation to Histopathology <i>Kiyoki Okada</i>	53
Staging Prostatic Cancer: A Comparison Between Presurgical Ultrasound and the Pathology of Excised Specimens <i>Hiroaki Miyashita</i>	58

Comparison of Transverse and Longitudinal (Linear Array Scanning) with Subsequent Prostatectomy Specimens	64
<i>Harold Jansen, Maarten P.W. Gallee and Fritz Schröder</i>	
Prostatic Acid Phosphatase and Prostatic Specific Antigen in the Era of Transrectal Ultrasonography	69
<i>Paul Lange and Michael Brawer</i>	
Serum Markers and Transrectal Ultrasound in Screening and Staging for Carcinoma of the Prostate	76
<i>Takahiro Akiyama, Masahiko Takada, Hironori Tsujihashi, Young-Chol Park, Seiji Kunikata, Kenjiro Kohri and Takashi Kurita</i>	
Open Discussion	84
MONITORING RESPONSE TO THERAPY	
Response/Progression Criteria for Evaluating Prostate Cancer	88
<i>Martin I. Resnick, Malcolm A. Bagshaw, F. Andrew Door, Marc B. Garnick, John Horton, George Prout, Jr., Thomas A. Stamey, Peter T. Scardino, Mario Eisenberger, Robert P. Gibbons, William Kaplan, James P. Karr, Frank Torti and Donald Trump</i>	
Screening Approaches for Carcinoma of the Prostate	98
<i>Martin I. Resnick</i>	
<u>Applications of Transrectal Ultrasound</u>	
Prostate Ultrasound: Clinical Indications and Implications 1988	101
<i>Matthew Rifkin</i>	
Monitoring the Effect of External Beam Radiation on Localized Prostate Cancer with Transrectal Ultrasound	106
<i>Richard M. Wolf, Nancy A. Dragone and Robert P. Huben</i>	
Kinetic Analysis of Prostatic Volume of Prostatic Cancer After Castration and its use for the Prediction of Prognosis	111
<i>Hiroshi Ohe and Hiroki Watanabe</i>	
Monitoring Prostatic Volume in Prostatic Cancer Patients Treated with LHRH Analogues	118
<i>Munekado Kojima, Hiroaki Miyashita, Hiroshi Ohe and Hiroki Watanabe</i>	
Transrectal Ultrasonography (TRUS) -- Volumetric Applications to Prostatic Carcinoma	124
<i>Fritz H. Schröder, Paul J. Carpentier, Petar A. Maksimovic and Frans M.J. Bentvelsen</i>	
Cell Kinetics of Prostate Cancer Studied with Ultrasound and S-Phase Fraction Using Bromodeoxyuridine Labeling	129
<i>Ryosuke Nemoto, Naoto Miyanaga, Yukiko Nishijima, Kenkichi Koiso and Masaoki Harada</i>	
Monitoring of the Three-dimensional Prostate Shape Under Anti-Androgen Therapy	137
<i>Shohei Nakamura</i>	

Transrectal Ultrasonography and Postsurgical Therapy	145
<i>Robert Huben</i>	
Ultrasonographic and Pathological Changes of Prostatic Carcinoma After Transurethral Cryosurgery	150
<i>Hideki Yoshida, Toyohiko Saitoh, Yoshio Higaki, Kazuyuki Tazawa and Kazuo Imamura</i>	
Transrectal Ultrasonography in the Diagnosis of Primary Transitional Cell Carcinoma of the Prostate: A Case Report	157
<i>Ayato Fujino, Akira Ishibashi and Ken Koshiba</i>	
Open Discussion	162
<u>Other Modalities/Issues</u>	
Prostate Cancer: Monitoring Responses to Therapy - The Bone Scan	168
<i>Gedes Grinis, Patrick Guinan, Vincent Lopez-Majano, Pratiba Sansi and Marvin Rubenstein</i>	
Radiologic Imaging in Monitoring Patients Following Therapy for Prostate Carcinoma	171
<i>Hedvig Hricak and Peter Carroll</i>	
CT of the Prostate	175
<i>Joseph LiPuma</i>	
Prostatic Calcifications	178
<i>Wolfgang Dahnert</i>	
Ultrasound Assisted Core and Aspiration Biopsy of the Prostate Gland -- Their Complementary Function in Prostate Cancer Diagnosis	183
<i>John Maksem</i>	
Open Discussion	186
<u>The National Institutes of Health Sponsored Ultrasound Network: Background, Objectives, and Methods</u>	196
<i>Joseph Smith, Martin Resnick, Peter Scardino</i>	
Open Discussion	200
SUMMATIONS	
Staging Committee Report	204
<i>Hiroki Watanabe, William Catalona, Peter Scardino, Howard Pollack</i>	
<i>Discussion</i>	
Monitoring Committee Report	208
<i>Martin I. Resnick, Paul Lange and Kenkichi Koiso</i>	
Index	211

ORGAN SYSTEMS PROGRAM STAGING CLASSIFICATION FOR PROSTATE CANCER*

Willet F. Whitmore, Jr., Committee Chairman

Panelists: William J. Catalona, John T. Grayhack, Gerald Hanks, Paul C. Peters, William U. Shipley, and Patrick C. Walsh

Consultants: Donald S. Coffey, F. Andrew Dorr, James P. Karr and Martin I. Resnick

PREAMBLE

Although a staging classification ideally should have qualities of permanence that obviate the problems associated with revisions, it is inevitable that advances in knowledge will justify future changes. The rationale to treatment and prognosis of some of the stage subdivisions in this classification is presumptive but whereas it would be impossible to make such subdivisions retrospectively, it will be simple to combine unnecessary subdivisions if future experience so dictates. The conscientious use of the proposed prostatic diagram will provide one basis for prospective collection of relevant information in the latter regard and will help resolve existing uncertainties regarding the importance of tumor location, absolute tumor size and relative tumor size to treatment and to prognosis. Furthermore, a diagram offers the potential for retrospective reassignment of T category if classification changes.

It is appreciated that existing and developing techniques of tumor assessment will improve the accuracy of clinical staging but the availability and perceived utility of such methods are not uniform. The specified minimal requirements do not exclude the concomitant use of whatever supplemental staging procedures may be elected but assure a minimal common denominator in staging.

It is recommended that this staging classification be utilized in conjunction with whatever other staging classification is employed.

OBJECTIVE

The objective is to provide a simple and reproducible clinical staging classification for primary adenocarcinoma of the prostate which has prognostic and/or therapeutic relevance.

RULES FOR CLASSIFICATION

(Minimal requirements) This classification is for use in histologically verified primary adenocarcinoma of the prostate. Digital rectal examination is the basis for T categorization. N categorization is variously based upon such clinical (C) imaging procedures as lymphangiography, computerized tomography, magnetic resonance imaging and urography, and/or upon histologic (H) confirmation of lymph node metastasis by aspiration biopsy, lymph node sampling or formal lymph node dissection. M categorization is based upon a minimum of chest x-ray, radionuclide bone scan, and at least two serum acid phosphatase determinations.

*Published with permission of Plenum Publishing Corporation. (Coffey, D.S., Resnick, M.I., Door, F.A., Karr, J.P. (eds.). In: A Multidisciplinary Analysis of Controversies in the Management of Prostate Cancer, pp. 295-297, 1988.)

For purposes of prospective studies, preparation of a two-dimensional diagram indicating the estimated actual size in centimeters and shape of the prostate, and the size, shape, location and degree of induration [1° degree or equivocal (▨ one crosshatch); 2° degree or moderate (▩ two crosshatches); 3° degree or stony hard (▨▨ three crosshatches)] of the tumor is recommended. The diagram should include a transverse sectional view(s), at a specified level(s) of the prostate, to characterize any asymmetry of the rectal surface of the gland. The diagram provides information regarding estimated absolute and relative (to the prostate) two-dimensional tumor size and location that supplements the specific T categorization and is intended to indicate the perceived actual size, shape and induration of the prostate and the tumor. As imaging techniques permitting objective measurements of prostatic size and/or tumor size evolve and are utilized, they will serve to supplement the prostatic diagram.

PRIMARY TUMOR (T)

T Category Definitions

T_x Anatomical relationships undefinable e.g. prior total prostatectomy; prior abdominopereineal resection of rectum.

T_A Digitally unrecognizable neoplasm, proved histologically.*

T_{A1} An estimated 5 percent or less of the total surgical specimen and of low or medium grade.

T_{A2} More than an estimated 5 percent of the total surgical specimen and/or of high grade.

T_{Ax} Implies T_A but stratification into A₁ or A₂ category is not possible (for whatever reason).

*Tumor volume may be assessed by estimating at low power the proportion of the total specimen involved by tumor. Examination of the entire specimen is necessary for validation of the T_{A1} category.

T_B Palpable tumor, not beyond the prostatic capsule. (This does not preclude palpable deformity of the margins of the gland provided such is judged to be within the capsule).

T_{B1} No more than one-half of one lobe in size, regardless of location.

T_{B2} Tumor more than one-half of one lobe but no more than one lobe in size, regardless of location.

T_{B3} Tumor greater than one lobe in size, or more than one palpable tumor.

T_{Bx} Palpable tumor within prostatic capsule but not otherwise characterized.

TBTC Palpable tumor extending beyond the prostatic capsule. The categorization of an extracapsular tumor involves specification both of the extent of apparent intracapsular involvement according to the TB category definitions indicated in the previous section and of the extent of extracapsular involvement according to the following TC category definitions:

TC₁ Extension beyond margin of gland unilaterally.

- TC₂ Extension beyond margin of gland bilaterally.
- TC₃ Extension beyond margin of gland with involvement of base of bladder and/or rectum and/or levator muscle(s) and/or pelvic side wall(s).
- TC_x Extension beyond prostatic capsule but not otherwise characterized.

LYMPH NODE STATUS (N)

N Category Definitions

Metastasis to the regional lymph nodes of the pelvis below the level of the aortic bifurcation may be clinically suspected from imaging studies (C), and/or histologically verified (H). The clinical imaging modality(s) should be specified.

- N₀ (C and/or H) No regional lymph node metastasis.
- N₁ (H) Microscopic regional lymph node metastasis. Histologic or cytologic confirmation is required.
- N₂ (C and/or H) Gross regional lymph node metastasis.
- N₃ (C and/or H) Extra regional lymph node metastasis. (This may include inguinal, periaortic, supraclavicular, axillary nodes, etc.)
- N_x Minimal requirements have not been met.

DISTANT METASTASIS STATUS (M)

M Category Definitions

Distant metastases (excluding lymph nodes).

- M₀ No evidence of metastasis.
- M₁ Elevated acid phosphatase only (repeated at least 2x; i.e. total of 3 elevations)*
- M₂ (V and/or B) Visceral (V) and/or bone (B) metastasis.
- M_x Minimal requirements have not been met.

*It is recognized that an elevated acid phosphatase determination may result from a still "localized" prostatic cancer.

THE JAPANESE STAGING SYSTEM

Hiroki Watanabe, M.D.

Department of Urology, Kyoto Prefectural University of Medicine, Kyoto, Japan

Two major systems have been widely used for staging prostatic cancer (PC). One of them is the so called "American system", modified by the National Prostatic Cancer Project (NPCP), and the other is the TNM classification. Both systems are essentially similar to the classical clinical staging proposed by Whitmore in 1956, as rectal examination (RE) is employed as the only means of assessing stage.

However, in many cases diagnosed by RE as being an early stage, one can frequently detect invasion beyond the capsule in specimens of the prostate after radical surgery. For that reason, it is generally said that staging by RE has a tendency to underestimate the stage.

Transrectal sonography (TRS) has been credited as being the most reliable technique for imaging the prostate. Among the various diagnostic capabilities of sonography, its suitability for staging PC was noticed even in its very early period of development [1] and it is highly praised without objection at present. It is, however, being performed in various institutions based upon different criteria, making it necessary to standardize the criteria in order to be able to compare and assess results. Thus, we have proposed a staging system for PC by TRS and have evaluated its efficacy in clinical cases belonging to various stages, and have compared it with RE and histological findings.

PROCEDURE

A cooperative research group for imaging modalities in urology, supported by a grant for scientific research from the Ministry of Education, Japan, was organized for 3 years, starting in 1981. The group consisted of 14 urologists in different academic institutions and was moderated by Dr. Hiroki Watanabe. The main objective of the group was the establishment of diagnostic criteria, including a staging system, for ultrasound and CT of the kidney, bladder, prostate and retroperitoneal lymph nodes. The completed list of criteria was authorized by the Japanese Urological Association and the Japan Society of Ultrasonics in Medicine and was published in a special report [2], a guideline for prostatic cancer [3], and the Japanese Journal of Medical Ultrasonics [4].

The staging system for PC by TRS, according to the authorized criteria, is herein described. Judgement is made on the following three items.

- deformity of prostatic section: DF
- interruption of capsular echoes: CA
- invasion into adjacent organs, such as the seminal vesicles or the bladder: NI

There are six staging steps, from UTO to UT4, as given in Table 1. The steps are first independently determined in each item, and then the highest step among the determinations for each item is indicated as the final stage of PC for the patient.

Table 1. UT Staging System

UT steps	Deformity	Interruption	Invasion	TNM	NPCP
UT0	DF ₀	CA ₀	NI ₀	T0	A ₁₋₂
UT1	DF _{0a}	CA ₀	NI ₀	T1	B ₁
UT2	DF ₁	CA ₀	NI ₀	T2	B ₂
UT3a	DF ₂	CA ₁	NI ₀	T2	B ₃ -C ₁
UT3b	DF ₂	CA ₂	NI ₁	T3	C ₂
UT4	DF ₂	CA ₃	NI ₂	T4	D ₁

Deformity; DF

DF₀: Deformity (-)
 DF_{0a}: Hypoechoic lesion
 DF₁: Asymmetry only
 DF₂: Deformity (+)

Capsular interruption; CA

CA₀: Interruption (-)
 CA₁: One portion <1/4 circumference
 CA₂: 2 or more portions or >1/4 circumference
 CA₃: 2 or more portions or >1/4 circumference + invasion to pelvic bone

Invasion; NI

NI₀: Invasion (-)
 NI₁: Invasion to seminal vesicle
 NI₂: Invasion to other organ

The first item, deformity of prostatic section (DF), includes findings of asymmetry, abnormal prolongation on the antero-posterior diameter, protrusion towards the rectum and less similarity among sections at different scanning levels. The finding of hypoechoic lesions, which suggests the existence of small cancer nodules, is also included in this item. There are four classes of deformity:

- DF₀: No deformity
- DF_{0a}: Hypoechoic lesion without deformity
- DF₁: Asymmetry only
- DF₂: Remarkable deformity

The second item, interruption of capsular echoes (CA), should be determined very carefully, because the capsular echoes become dim, giving a false invasive sign, when the tangential line of the capsule coincides with the beam line of the projected ultrasound. This item is also comprised of 4 classes: