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Current Concepts and Evaluation of Uro-Rectal Diseases by Transrectal Ultrasound: A Review

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Abstract

This article specifically discusses the clinical importance and current role of transrectal ultrasound (TRUS) to index the clinical suspicion of uro-rectal diseases. The traditional digital rectal examination is an inadequate method with low sensitivity and specificity, and confidence level for uro-rectal diseases. TRUS provides further imaging modalities, computerized tomography, magnetic resonance imaging, and three-dimensional reconstruction. Prostate cancer can be diagnosed in patient with refractory prostate-specific antigen to increase to increase diagnostic modalities with fusion biospies. The outcome of uro-rectal diseases can be improved by utilization of initial TRUS, a non-invasive and radiation free, extension of physical diagnosis.

Keywords: Prostate; Uterus; Cervix; Rectum; Seminal vesicles; Genetics; Presacral space; Transrectal ultrasound

Abbreviations:

DRE: Digital Rectal Examination; PSA: Prostate-Specific Antigen; TRUS: Transrectal Ultrasound; PMI: Prostate Mechanical Imaging

Digital Rectal Exam

Males

Introduction

In the United States, prostate cancer is the second most leading cause of death among men. Each year in the United States, approximately 200,000 men are diagnosed with prostate cancer and 30,000 die due to this cancer [1] (Table 1). Digital rectal examination (DRE) and prostate-specific antigen (PSA) have improved detection rates and can shift the diagnosis of prostate cancer to low grade, organ confined disease (Table 2). Early diagnosis of prostate cancer is now a possibility. Palpable uro-rectal disease detection is possible if within the length of your index finger; the configuration used for DRE. Prostate cancer can be firm or soft on DRE. Suspicion of prostate cancer can be indicated by elevated PSA [2]. However, due to its limitations, DRE can hinder the ability to accurately diagnose uro-rectal diseases, leading to delayed diagnosis (Table 3). DRE is also not accurate in determining the size of the prostate gland. It fails to measure the median lobe or subcervical lobe that extends into the bladder. In contrast, transrectal ultrasound (TRUS) scans 360 degrees of the rectal lumen to detect surrounding uro-rectal diseases, below the pelvic brim, and 12 centimeters from the anus [3].

Prostate-Specific Antigen (PSA)
Prostate Health Index
Prostate Cancer Antigen 3

Table 1: Current Biomarkers which facilitate detection of Prostate Cancer [4].

Prostate
Prostate size [5,6]
Prostate nodules [5]
Prostatic abscess [7]
Prostatitis [8]
Benign Prostate Hyperplasia [9]
Prostate Cancer [10,11]
Prostatic Cysts [12]
Prostatic Calcifications
Trapped stone in the prostatic urethra [13]
Perivesical Lipomatosis [14]
Palpable ano-rectal masses
Diverticulitis abscess
Pelvic Abscess
Blumer-shelf lesions/lesions of the recto-vesical space [15]
Perianal Paget's Disease [16]
Seminal Vesicles
Cysts of the seminal vesicles [17]
Seminal Vesicle calcifications

Zinner Syndrome [18]
Presacral/Retrorectal Masses
Neurilemmoma [19]
Tailgut cysts
Rectal
Rectal Calcifications
Colorectal carcinoma [20]
Thrombosed Hemorrhoids [21]
Retrovesical masses [22]
Prostatic utricle cysts
Prostatic abscess
Seminal vesicle hydrops
Seminal vesicle cyst [23]
Seminal vesical empyema
Ectopic ureterocele
Myxoid liposarcoma
Malignant fibrous histiocytoma
Fibrous fossa obturatoria cyst
Hemangiopericytoma
leiomyosacoma
Anal Fissure [24]
Megarectum [25]
Sphincter activity in neurological diseases
Spinal Cord injury [26]
Cauda Equina Syndrome [27,28]
Neurogenic bladder [29]

Table 2: Diseases identified by digital rectal examination in males.

Prostate Cancer and other malignancies
Prostatic Adenoma
Prostatic Calcification
Prostatic Calculi
Impacted stones in Prostatic Urethra
Prostatic Cysts
Prostatitis (different types: CGP, allergic)
Fungal infections of prostate
Tuberculosis
Post Injections of Sclerorising agents of hemorrhoids
Post Healed biopsy of Prostate
Post Brachytherapy
Post angio-infraction of Prostate
Linitis plastica of Rectum
Metastatic Lesions of Prostate
Blumer-Shelf Lesions
Sclerosing agents injected into Prostate Gland
Resolved prostatic abscess
Stones and calcification of seminal vesicles
Post-TURP and Surgery of Prostate
Recurrence of Prostate Cancer
Thrombosis internal hemorrhoids

Table 3: Differential diagnosis of palpable prostatic nodules on digital rectal examinations.

Females

Introduction

DRE is an essential part of diagnosing uro-gyneco-rectal diseases in female patients and planning a proper, early treatment program. Tompkins et al. stated that DRE can result in positive findings of rectal diseases. During her 50 years in practice, DRE aided her to discover three rectal polyps. A DRE conducted by a proctologist determined a rectal mass, later found to be rectal carcinoma. DRE has correctly diagnosed patients with rectoceles, enteroceles, and prolapses. DRE should be routine, following a pelvic examination [2]. DRE with bimanual pelvic examination is important in detecting these diseases (Table 4).

Cervix
Carcinoma of the cervix [30]
Palpable ano-rectal masses
Diverticulitis [31]
Pelvic Abscess
Biological collection in Pouch of Douglas
Fecal incontinence [32]
Pelvic organ prolapse [33]
Proctitis
Endometriosis [34]
Vulva
Carcinoma of Vulva [30]
Vagina
Carcinoma of Vagina [30]

Presacral/Retrorectal Masses
Tailgut cycts [35,36]
Epidermoid cysts [36,37]
Dermoid cysts [36]
Cystic rectal duplication [36]
Neurenteric cysts [36]
Mucus-secreting presacral cyst [38]
Rectal
Rectal calcification
Rectal necrosis [39]
Prader-Willi Syndrome [40]
Colorectal carcinoma [20,30]
Thrombosed Hemorrhoids [21]
Anal Fissure [24]
Megarectum [25]
Sphincter activity in neurological diseases
Spinal Cord injury
Cauda Equine Syndrome

Table 4: Diseases identified by digital rectal examination in females.

Transrectal Ultrasound (TRUS)

In both males and females, TRUS is used as an extension of DRE. This helps further diagnose and identify different uro-rectal diseases. TRUS is beneficial in detecting diseases of the prostate (Table 5), cervix, and uterus. TRUS is currently used to perform transrectal biopsy of the prostate. During this guidance procedure, complications may occur (Tables 5-9). If lesions are suspected on TRUS (Table 6), further diagnostic modalities should be considered, which include computerized tomography, magnetic resonance imaging, and specific diagnostic biopsies and treatment. TRUS is the first line modality for any suspected uro-rectal diseases, for both males and females [41]. TRUS has many advantages that other modalities lack. TRUS is economically beneficial, there is no radiation or contrast applied during administration, and with no preparation required, it can be immediate and time saving [42]. One thing that needs to be considered is if the patient is allergic to latex; if so, non-latex sheaths can be used during examination. TRUS is an ideal modality for diagnosing uro-rectal diseases in adults, however it is not possible in children due to differences in anatomical configuration and children's intolerance of pain. Current TRUS probes are not designed to diagnose uro-rectal diseases in children. Current advances in TRUS technology include multi-dimensional imaging with and without contrast [43].

Colorectal trauma and rectal foreign bodies can present a challenge because they can be asymptomatic. DRE can sometimes miss foreign bodies, which can later lead to problems. TRUS, however, can detect foreign bodies and prevent further complications [44].

Benign Prostatic Hyperplasia [45]
Ectopic Prostatic Tissue [46]
Prostate Cancer [47]
Prostatitis [48]
Prostatic abscess [49]
Emphysematous Prostatitis [50]

Table 5: Transrectal ultrasound detectable diseases of the prostate.

Importance of TRUS in Males

Guidance for Biopsy [51]
Assessment of prostate volume before medical, surgical, or radiation therapy and to calculate prostate specific antigen [52,53]
Real-time guidance for placement of brachytherapy seeds [54]
Assessment of lower urinary tract symptoms [55]
Assessment of congenital anomalies [56]
Infertility [56]
Hematospermia [57]
Evaluation of recto-vesical shelf (Blumer Shelf) [15]
Evaluation of neurovascular bundle [58]
Evaluation of Prostate cancer [59]
Benign Prostate Hyperplasia [60]

Table 6: Indications of transrectal ultrasound in males.

Importance of TRUS in Females

Cervical masses [61]
Cervicitis Transformation Zone
Nabothian Cyst
Endocervical Polyp
Microglandular Hyperplasia
Endometriosis Leiomyoma of Cervix
Mesonephric Remnants
Cervical Intraepithelial Neoplasia [62]
Adenocarcinoma-in-situ of Cervix [62]
Squamous Cell Carcinoma of Cervix [63]
Superficially Invasive Carcinoma of Cervix
Papillary Squamotransitional Carcinoma
Verrucous Carcinoma of Cervix
Adenocarcinoma of Cervix [64]
Adenoma Malignum
Adenosquamous Carcinoma of Cervix

Glassy Cell Carcinoma of Cervix
Adenoid Basal Carcinoma of Cervix

Table 7: Diseases of the cervix identified by transrectal ultrasound.

Adenomyosis
Uterine Fibroids [65]
Endometrial Polyps
Retroversion of the Uterus

Table 8: Diseases of the uterus identified by transrectal ultrasound.

Complications of Transrectal Biopsy of Prostate

Urosepsis [68]
Renal Failure [69]
Discitis [69]
Rectal Bleeding [70,71]
Hematoma [72-74]
Hematochesia [75,76]
Urinary Retention [77]
Disseminated Intravascular Coagulation [78]
Fournier's Gangrene [79]
Blindness [80]
Prostatic Abscess [81]
Seminal vesicle abscess [82]
Bacterial meningitis [83,84]
Prostatitis [85]
Metastasis to Colon [86]
Local Recurrence [87]
Epidural Abscess [88]
Symphysitis [89]
Hematospermia [90]
Ischio-rectal abscess [91]
Ureteral Injury [92]
Malakoplakia [93]

Table 9: Complications of transrectal biopsy of prostate [66,67].

Prostate Mechanical Imaging (PMI)

Prostate mechanical imaging (PMI) uses real-time imaging of the prostate and assesses the prostate nodularity [94]. Weiss et al. evaluated the PMI device in 168 patients needing a prostate evaluation. In 84% of the cases, PMI reconstructed three-dimensional and two-dimensional cross-sections of the prostate. This technique aided in identifying patients with diseases of the prostate [95]. PMI provided a better diagnosis than DRE, however PMI is still an inferior technique to TRUS because PMI only measures the morphology of the prostate.

Endorectal Coil

Endorectal coil is an additional modality that can improve the detection and diagnosis of uro-rectal diseases [96]. Endorectal coil assists in the diagnosis of prostate cancer. Image obtained by endorectal coil provides and index of suspicion for biopsy of these lesions, in patients with elevated PSA. Endorectal coil is a critical imaging modality to detect preprostatic extension of prostate cancer, including seminal vesicles [97]. Fusion biopsy is currently used to improve the diagnosis of prostate cancer [98].

Presacral Space/Retrorectal Space

The critical importance of diseases in the presacral space is not usually described in DRE. TRUS provides a clear imaging of the presacral space and its diseases (Table 10). Congenital tail-gut diseases and retroperitoneal diseases, extend into the presacral space and can be detected earlier by TRUS.

Anatomy of the Presacral Space/Retrorectal Space

The presacral or retrorectal space is a potential space in front of the sacrum and behind the rectum. The anterior boundary is bounded by the mesorectum. Superiorly it is bounded by the peritoneal reflection, and inferiorly, the retrosacral fascia. The spuralevator space is located below the presacral/retrorectal space. Lateral extension of the presacral space includes the ureters, iliac vessels, lateral stalks of the rectum, and sacral nerve roots. Contents of the presacral space include loose connective tissue, middle and superior rectal vessels, and branches of the autonomic nervous systems. Important embryological remnants in the presacral/retrorectal space include the hindgut, neuroectoderm, and totipotent cells, which can contribute to tumors arising in this space [99]. The presacral space can present with various diseases (Table 10).

Diseases of the Presacral Space/Retrorectal Space

Anterior Sacral Meningocele [102]
Tailgut cycts [35,36]
Neurenteric cysts [36]
Cystic rectal duplication [36]
Epidermoid cysts [36]
Epidermoid tumor
Dermoid cysts [36]
Cystic sacrococcygeal teratoma
Anal duct or gland cysts
Necrotic sacral chordoma
Osteoma
Simple bone cyst

Aneurysmal bone cyst
Giant cell tumor
Ewing sarcoma
Osteosarcoma
Chondrosarcoma
Neurofibroma
Ependymoma
Neuroblastoma
Schwannoma
Dural ectasia

Table 10: Diseases of the presacral space/retrorectal space suspected on transrectal ultrasound [100,101].

Genetic Origins of Uro-Rectal Diseases

There are certain genetic associations that is related to uro-rectal diseases (Table 11). Mutations, up regulations, and down regulations can result in the pathogenesis of certain uro-rectal diseases. Manifestations of genetic issues can result secondary effect of the uro-diseases as well. All these uro-rectal diseases can be detected by TRUS.

Prostate Cancer [107]
Perianal Paget's Disease [108]
Myxoid Liposarcoma [109]
Malignant Fibrous Histiocytoma [110]
Hemangiopericytoma [111]
Cauda Equina Syndrome [112]
Carcinoma of the Cervix [113]
Carcinoma of the Vagina [114]
Epidermoid Cysts [115]
Prader-Willi Syndrome [116]
Colorectal Carcinoma [117]
Benign Prostate Hyperplasia [118]
Microglandular Hyperplasia [119]
Adenocarcinoma of Cervix [120]
Adenoma Malignum [121]
Adenosquamous Carcinoma of Cervix [122]
Glassy Cell Carcinoma of Cervix [123]
Adenoid Basal Carcinoma of Cervix [124]
Adenomyosis [125]
Uterine Fibroids [126]
Endometrial Polyps [127]
Hematoma [128]
Fournier's Gangrene [129]
Malakoplakia [130]
Aneurysmal bone cyst [131]
Ewing Sarcoma [132]
Osteosarcoma [133]
Chondrosarcoma [134]
Neurofibroma [135]
Neuroblastoma [136]
Schwannoma [137]
Chordoma [138]
Malignant Schwannoma [139]
Hemangioma [140]
Myelolipoma [141]
Leiomyoma [142]
Villous Adenoma [143]
Solitary Fibrous tumor [144]
Castleman disease [145]
Lymphoma [146]
Gastrointestinal Stromal Tumor [147]
Epithielial Malignancies [148]
Teratoma [149]
Neuroendocrine tumors [150]
Anorectal melanoma [151]
Kaposi Sarcoma [152]
Lymphogranuloma Venerum [153]
Currarino Syndrome [154]

Table 11: Genetic contributions for uro-rectal diseases.

Summary

Traditional digital rectal examination in males and females, fails to provide an index of clinical suspicion in uro-rectal diseases. Transrectal ultrasound should be the first modality to suspect uro-rectal diseases as described in this article. Other current imaging modalities will expand the detection of diseases suspected by TRUS. Specific diseases where genetics play a role in the pathogenesis are mentioned in the article. Current literature for imaging modalities, diseases of the uro-rectal region, including the presacral space is reviewed.

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