TRANSPERINEAL SONOGRAPHY of the PELVIC FLOOR: An Overview

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• None to disclose
• I’m not an astronaut, but people think I’m “spacey” at times
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Overview of Presentation Topics

• Clinical and Imaging (TPS and MRI) perspectives of Pelvic Floor Disorders
• Sonographic Instrumentation/Techniques
  – 2D, 3D TPS
  – Potential for Matrix Array Transducer/Probe
• Pertinent Anatomy
  Normal and Abnormal TPS findings
  • Static
  • Dynamic

Pelvic Floor Disorders (PFD)*

• Affect up to 50% of postmenopausal women
• Of these, 10-20% will be symptomatic
• Of affected women, 1 in 10 will have surgery
• Over next 30 years, there is a projected 45% increase in demand for imaging/clinical management/surgery of PFD

Pelvic Floor Disorders and what you can visualize with TPS

• Stress urinary incontinence
  – Funneling of internal urethral meatus on Valsalva or at rest
  – Retrovesical angle greater than 120 degrees on Valsalva
  – Bladder neck descent greater than 3 mm on Valsalva
• Pelvic organ prolapse
  – Movement of pelvic organs below reference line
  – (TPS more subjective than MR POPs)
• Fecal incontinence
  – Thinning/disruption of int/ext anal sphincters

TPS for Pelvic Floor Disorders, cont’d.

• Post op assessment of prolapse and/or incontinence surgery complications
  2D/3D TPS affords DYNAMIC DEPICTION of tape/mesh including
  Tensionless Vaginal Tape (TVT), Transobturator Tape (TOT) (Monarc), Perigee, Apogee
  Injected bulking agents (Mastopatique)
3 Compartments-
**ANTERIOR**: bladder, urethra
**MIDDLE**: vagina, uterus
**POSTERIOR**: rectum, anus

ANTERIOR-urinary bladder and urethra=UROLOGIST
MIDDLE-uterus/cervix=GYNECOLOGIST
POSTERIOR-rectum/anus=RECTAL (GI) SURGEON

Cystocele

Rectocele

Uterine prolapse

Healed Laceration And Uterine Prolapse
Enterocoele Rectocoele And Uterine Prolapse
PFD are usually Multi-COMPARTMENTAL
**Anatomy of Pelvic Diaphragm**

*Warning*: It’s complicated

Vesalius, 1623

**2D-TPS of pelvic diaphragm in the midline sagittal plane**

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**Pelvic Diaphragm**

(as viewed from below)

Equivalent to reconstructed (virtual) AXIAL PLANE

- Levator ani muscles
- Pubovisceral "complex" mm
  - Puborectalis mm
  - Pubococcygeus mm
- Endopelvic fascia
- Ligaments

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**2D-TPS of pelvic diaphragm in the midline sagittal plane**
Select transducer/probe according to area of interest

- Small, confined places (vagina)
  - Use tightly curved convex array (TVS)

- Relatively flat, open surfaces (perineum)
  - 2D linear array
  - 3D curvilinear with mechanical sector
  - 4D (Matrix array) small footprint electronic/phased array sector

- Think of using different surgical instruments relative to desired function

Specialized US Transducer/Probes (c/o Philips Healthcare Systems)

<table>
<thead>
<tr>
<th>Array Type</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical / Annular Array</td>
<td>2D, M-Mode, Doppler</td>
</tr>
<tr>
<td>Linear / Sector Electronic Array</td>
<td>2D, M-Mode, Doppler, Color Doppler</td>
</tr>
<tr>
<td>Curved Electronic Array</td>
<td>2D, M-Mode, Doppler, Color Doppler</td>
</tr>
<tr>
<td>Mechanical Curved / Linear Hybrid Array</td>
<td>2D, M-Mode, Doppler, Color Doppler, 3D/4D, MPR</td>
</tr>
<tr>
<td>2D Electronic Matrix Array</td>
<td>2D, M-Mode, Doppler, Color Doppler, 3D/4D, BiPlane, MPR</td>
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</tbody>
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2D US transducer

Image Orientation

TPS of pelvic diaphragm in the midline sagittal plane

TPS of Pelvic Diaphragm in the midline sagittal plane— as displayed on screen
Side-by-side comparison of acquisition vs display of TPS

- acquisition
- display

Actual TPS of midline sagittal

Dynamic 3D TPS-normal sagittal and axial ONLY

3D Transperineal US

Normal Pelvic Floor Dynamics As Depicted with 3D TPS
Axial 3D TPS of normal Transobturator Tape (TOT)

REMEMBER: AXIAL PLANE TPS IS RECONSTRUCTED VIRTUAL—CAN BE DONE IN REALTIME, TOO

Terms used to describe Transperineal Sonography of Pelvic Floor

- Technique:
  - 2D linear array, convex linear (transvaginal probe)
  - 3D (“hybrid” probe)
- Scan planes:
  - sagittal
  - axial
  - coronal
- Pelvic Floor Structures:
  - Urethra
  - Vagina
  - Uterus
  - Rectum/anus
  - Levator ani muscles

TPS and Anatomy/Orientation/ “Field of View”

2D TPS
- Good—Easiest scan plane/field of view
- Bad—can not show true axial plane of majority of pelvic diaphragm orientation
- Probably best method to start with—then progress to 3D TPS
Quantifying bladder neck descent

3D TPS-
Volume rendered

Vagina
Urethra
Rectum/anus
Pelvic floor muscles
TPS reference line for determining PROLAPSE

MR-Pubococcygeal Line (PCL)

Uterine prolapse

MR-PCL H and M lines (H=hiatal, 5 cm; M=mid, 2 cm)
Cystocele (MR=Q tip test)

Rectocele (during defecation)

Transducer placement for translabial/perineal sonography (TPS)

TPS Technique

- Supine or erect
- 2D-TPS, 3D-TPS, 3D-TUI
- Transperineal curvilinear transducer
  - 4 MHz or more, 5 cm footprint or more
  - cover with glove, apply minimal pressure
  - speckle reduction/post processing
- Image at rest and Valsalva (strain)-cineloop
- Measure change with Valsalva
  - Bladder neck descent (N<less than 30 mm)
  - Retrovesical angle (N=90-120 degrees)
  - Hiatal area (N<less than 25 cc)

Advantages of TPS (over MR, Fluoroscopy)

- No ionizing radiation, dynamic
- Cheaper
- Easier on patient, examiner
- Can visualize TVT, slings, meshes

Limitations of TPS

- Multicompartment disease
- Operator dependant
- Limited field of view
- Standards-MR can assess/quantify prolapse
  - By POP-Q (pelvic organ prolapse quantification)
- Equipment variations
TPS with a 2D US transducer = aka-simple, “straightforward” apps

Determination of bladder neck mobility

Pelvic floor ultrasound in the midsagittal plane at rest and maximal Valsalva with arrow identifying inferior margin of symphysis pubis, ie, point of reference for measurement of bladder neck position (*)

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Pelvic floor ultrasound in the midsagittal plane at rest and maximal Valsalva with arrow identifying inferior margin of symphysis pubis, ie, point of reference for measurement of bladder neck position (*)

Cystocele with intact retrovesical angle

Isolated cystocele associated with prolapse and voiding dysfunction rather than stress incontinence. Retrovesical angle on Valsalva is at 90-120 degrees, and bladder base is lower than bladder neck.

TPS reference line

Clinical Rectocele

All 3 conditions can manifest as clinical rectocele and are impossible to distinguish on examination
Standard acquisition screen of 3D Transperineal Sonography

Anterior urethral diverticulum on 3D TPS

Rectocele on 3D transperineal US

Mesh “Mishaps”
- Location? “contraction” or “retraction”
  - Mesh did not remain flat but folded upon itself during implantation or immediately after closure
  - ? Dislodgement of anchoring arms
  - TPS can provide dynamic assessment of mesh (polypropylene) implants (MRI can’t)

Picture of mesh

Axial 3D TPS of normal Transobturator Tape (TOT)
Suburethral slings as seen on TPS – midsagittal plane

Transretzius (A) and transobturator (C) slings are essentially indistinguishable. Both are echogenic and located dorsal to midurethra.

Suburethral slings as seen on 3D TPS – axial plane

The distinction between slings is quite obvious in the axial plane. In B, a tension-free vaginal tape (TVT) is curving ventrally toward symphysis pubis, whereas in D, a Monarc tracks laterally toward insertion of puborectalis muscle and obturator foramen.

Patient after TVT division due to de novo urgency, urge incontinence, and chronic mild obstruction

Midsaggital plane. Arrow indicates most likely tape location, but tape is invisible in this plane.

Coronal (B) and axial (C) views with 2 free tape ends (arrows).

Axial plane rendered volume also demonstrates gap between 2 tape ends.

Anterior and posterior compartment mesh implants

Patient is s/p successful Perigee (P) and Apogee (A) implantation. Midsaggital plane (A) demonstrates absence of prolapse on Valsalva, despite severe levator ballooning evident in the axial plane (B) in this patient with bilateral avulsion injury.

Right-sided avulsion of the puborectalis muscle

Delivery-related levator trauma as seen on exploration of large vaginal tear after vaginal delivery.

As imaged on 3D TPS.

As imaged on MRI.

Rendered volume (axial plane) of typical unilateral avulsion

Prior insertion of muscle (long arrow), now completely devoid of any hyperechogenic tissue, and retracted puborectalis muscle (short arrow).
Quantification of trauma on multislice/tomographic ultrasound imaging (TUI)

Typical right-sided levator defect (*) measuring about 2 cm (dorsoventral) width and at least 1.75 cm (craniocaudal) depth as it is apparent in all 8 slices.

Cystocele/Rectocele s/p Perigee placement

Patient with large cystocele (A) who developed rectocele (B) 6 months after successful Perigee anterior compartment mesh (which is invisible due to shadowing from air-filled rectocele).

Rectocele & Cystocele s/p rectocele rx

Patient with large rectocele (C, imaged here before full development of large rectocele) who developed cystocele (D) 6 months after successful defect-specific rectocele repair.

Dynamic 2D and 3D TPS-Illustrative cases

Adapted from Dietz, HP
Pelvic Floor Sonography
In Sonography in O/G, MGH, 2011
(www.sonobook7e.com)

Cystocele/Failed TO mesh

Normal TVT
Rectocele/Enterocele

Cystocele/Rectal intussception

Cystocele/Rectocele/Avulsions

TPS of Pelvic Floor Disorders - CONCLUSIONS

- Pelvic floor disorders are a common and complex problem
- Transperineal Sonography affords real time (dynamic) imaging as well as 3D/4D and can visualize tape/slings/mesh
- TPS enables better understanding of the dynamics and potential treatment of pelvic floor disorders

Standard acquisition screen of 3D Transperineal Sonography

Mid sagittal
Coronal
Axial plane
Rendered axial plane

References*

(*=used with permission)

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HIGHLY RECOMMENDED
RECENT PRESENTATION!!!!

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