CLINICAL APPLICATION OF IMAGING IN UROGYNECOLOGY

Transperineal orientation

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Content

• Anatomy

• What is Transperineal ultrasonography
  – 2 dimensional (2D)
  – 3 dimensional (3D)
  – 4 dimensional (4D)

• Clinical applicability
Schematic view of the LAM from below after the vulvar structures and perineal membrane have been removed and urethra and vagina have been transected just above the hymenal ring, showing the arcus tendineus levator ani (ATLA); external anal sphincter (EAS); puboanal muscle (PAM); perineal body (PB) uniting the two ends of the puboperineal muscle (PPM); iliococcygeal muscle (ICM); puborectal muscle (PRM).

Advantages ultrasonography

- Absence of ionising radiation
- Relative ease of use
- Minimal discomfort
- Cost-effectiveness
- Relatively short time required
- Wide availability
Position

- Empty bladder
- Dorsal lithotomy position
- Hips flexed and abducted
- Convex transducer positioned on perineum

ULTRASOUND CHARACTERISTICS
2D TPUS

• Convex probe 3-6 MHz
• Field view at least 70°
• Dynamic studies: contraction and valsalva
2D, Midsagittal plane

2D, Midsagittal plane

- Anterior, central and posterior compartment
2D, Midsagittal plane

P pubic bone; U urethra; B bladder; A anal canal; LAM levator ani muscle
3D TPUS

- Convex probe 4-8 MHz
- Axial, tomographic plane
- Field view up to 85°
TPUS
Symmetric rendered volume

- 2-3 cm thick, rendered caudally to cranially

PB pubic bone; U urethra; V vagina; A anal canal; LAM levator ani muscle
Tomographic Ultrasound Imaging (TUI)

• To assess the entire puborectalis muscle and its attachment to the pubic rami
TUI

- Axial plane (c-plane), 2.5 mm slice intervals
- 5 mm below plane of minimal hiatal dimensions to 12.5 mm above: 8 slices
4D TPUS

- Convex probe 4-8 MHz
- Axial, tomographic plane
- Field view up to 85°
- Dynamic studies: contraction and valsalva
CLINICAL APPLICABILITY
Stress urinary incontinence

• Bladder neck mobility
  – Bladderneck – symphysis distance
    • Difference rest – Valsalva: cut-off 25 mm hypermobility
      
      Dietz UOG 2004

• Funnelling internal urethral meatus
  – Urethral length: bladder neck to external urethral orifice
    
    Schaer 1998
Anterior vaginal wall cysts – Imaging

- Urethral diverticula, abscesses, tumors, cysts
Stress urinary incontinence – Imaging

- Tapes anti-incontinence surgery
  - Position: midurethral sling (not necessary)
  - Minimum gap on Valsalva: associated negatively with voiding dysfunction and positively with SUI and UUI
  - Tape division: location, postoperative confirmation

_Dietz 2007, Chantarasorn 2010_
Correctly placed tape
Wrongly placed tape

FIGURE 1. Three-dimensional ultrasound of urethral mesh. Three-dimensional ultrasound (transverse view of midurethra) demonstrated complete transection of the periurethral fascia (A) by a mesh sling (B) performed for stress urinary incontinence.

TVT + Macroplastique
TVT + Macroplastique

B bladder; PB pubic bone
Endovaginal ultrasound
B bladder; PB pubic bone; M macroplastique, TVT
Postoperative voiding dysfunction

Height x depth x 5.6 = postvoid residual in mm

Dietz IUJ 2012
Bladder wall thickness

- Overactive bladder: bladder wall thickness >5mm
  - Measure at trigone, dome, anterior wall

  Khullar 1996
  Lekskulchai 2008

- Measurements differ depending technique
  - Vaginal measurements are significantly lower

  Kuhn 2010
Bladder wall thickness

PB pubic bone; U urethra; B bladder; LAM levator ani muscle
Faecal incontinence – Imaging

- Golden standard EAUS
- TPUS
  - Advantage: no distortion of the anal canal
  - Disadvantage: excessive pressure $\rightarrow$ errors

Valsky 2012
An intact sphincter shown at the deep (a), superficial (b) and subcutaneous (c) level using TPUS. E, EAS; I, IAS

3D TPUS normal sphincter

Internal anal sphincter

External anal sphincter

A anal canal; R rectum
3D TPUS normal sphincter TUI
2D TPUS sphincter defect

EAUS remains the golden standard. EVUS and TPUS are not sensitive enough to identify an underlying sphincter defect.

Image: A defect in the EAS (white arrows) and IAS (open arrows) on
- TPUS (a) and
- Endoanal ultrasound (b)

Roos 2011

3D TPUS sphincter defect
3D EAUS sphincter defect

Good agreement
2D EAUS – 3D TPUS

Oom 2011
Levator hiatus

- Plane of minimal anteroposterior dimensions
- Qualitative assessment of levator ani muscle and insertion on inferior pubic ramus

PB pubic bone;  
U urethra;  
V vagina;  
A anal canal;  
LAM levator ani muscle

*1 hiatus area;  
*2 anteroposterior diameter;  
*3 transverse diameter
Levator ani muscle injuries

- Disconnection of muscle from its insertion on the inferior pubic ramus and pelvic sidewall
  - Santoro 2011

- Overstretching during second stage of labour
  - 10-36% of women during first vaginal delivery
  - Dietz OG 2005, Shek OG 2009
Levator ani muscle injuries

• Avulsion, on contraction
  - Muscle strength reduction
  - Alteration of anatomy
    • 2.3 times > cystocele
    • 4 times > uterine prolapse

Dietz BJOG 2008
Levator ani muscle injuries

• Enlargement of hiatus, on valsalva
  – Excessive loading of ligamentous and fascial structures $\rightarrow$ connective tissue failure $\rightarrow$ prolapse
  – Area $>25\text{cm}^2$ $\rightarrow$ pelvic organ prolapse (POP)

*Dietz UOG 2008*
Hiatus at rest

*1 Hiatus area 223.6 mm²
*2 Anteroposterior diameter 73.3 mm;
*3 Transverse diameter 39.4 mm
Hiatus contraction

Hiatus area 136.3 mm$^2$;
Anteroposterior diameter 52.7 mm;
Transverse diameter 28.0 mm
Hiatus valsalva

Hiatus area 306.5 mm$^2$;
Anteroposterior diameter 80.7 mm;
Transverse diameter 38.4 mm
Cystocele – Imaging
Enterocele

- Herniation of bowel loops into the vagina
  - Differentiation from true rectocele
  - Good agreement TPUS and defecography
  - Vaginal prolapse, obstructed defecation, voiding dysfunction

*Santoro 2011, Steensma 2010*
Enterocele – Imaging
Rectocele

• Etiology: thinning or tear rectovaginal septum
  - Prolapse, obstructed defecation, incomplete emptying, vaginal digitation and straining at stool

  Santoro 2011

• Gold standard: defecography
  - TPUS comparable results
  - Ultrasonography not to replace defecography

  Perniola UOG 2008, Dietz UOG 2005

• Herniation of depth of over 10 mm: diagnostic

  Dietz UOG 2005
Rectal intussusception

- Invagination of rectal wall into rectal lumen
  - Obstructed defecation, incomplete emptying, vaginal digitation and straining at stool

Santoro 2011

- Valsalva: intussusception enters anal canal or exteriorises beyond anal canal

Perniola UOG 2008
Rectal intussusception
Uterus

CU

Triple layer endometrium

CU corpus uteri
Uterine prolapse

- Downwards displacement beyond halfway vagina
- Effect of descending uterus on bladder neck, urethra or anorectum

Dietz UOG 2001
Uterine prolapse – Imaging
Assessment of MESH-implants

- Mesh especially used in recurrent prolapse
  - Levator avulsion is a risk factor

- Advantages of ultrasonography
  - Position, extent and mobility of implants
  - Help with assessment of surgical techniques
  - Determination of functional outcome

Model 2010

Santoro 2011
Correctly placed MESH

Transobturator armed mesh on Valsalva. Arrows show mesh length in the midsagittal (left) and the coronal plane (center, right). S = symphysis, B = bladder, R = rectum, L = levator ani. The horizontal line in the left image is a line of reference placed through the inferior symphyseal margin.

Dislodgment of superior transobturator anchoring arms. The result is a high cystocele as observed after colposuspension or fascial sling. A, midsagittal view at rest, B at half-Valsalva, and C at maximal Valsalva. SP = symphysis pubis, B = bladder, S = suburethral sling, M = mesh. The cranial aspect of the mesh is unsupported and highly mobile.
Summary

- Symptoms
- Clinical examination
- Ultrasonography: identification of anatomical and functional abnormalities
- Accurate pre-operative assessment
- Management plan

*Remember to treat your patient, not the scan findings*