Imaging of Pelvic Floor Weakness

Dr Susan Kouloyan-Ilic
Radiologist
Epworth Medical Imaging
The Women’s, Melbourne
Outline

- Overview and Epidemiology
- Risk Factors, Causes and Results
- Review of Relevant Anatomy
- Weakness in Compartments; Surgical Treatments
- Urodynamics
- Dynamic MRI Pelvic Floor
Overview

- Definition
  - weakening of the pelvic floor
  - leads to abnormal descent of the urinary bladder, uterovaginal vault, rectum
  - results in urinary incontinence, fecal incontinence and pelvic organ prolapse
  - can be debilitating

- Epidemiology
  - affects ~ 50% women over age of 50
  - annual cost $12 billion (USA)
  - 11% lifetime risk of undergoing at least 1 operation
**Causes**
- weakness of the support structures of the pelvis:
  - pelvic muscles
  - ligaments
  - fasciae

**Result**
- urinary or bowel incontinence
- sexual dysfunction
- pelvic organ prolapse
Anatomy

- 3 Compartments
  - Anterior
    - urinary bladder
    - urethra
  - Middle
    - Uterus
    - Cervix
    - Vagina
  - Posterior
    - Rectum
Anatomy

- Urogenital Hiatus
- opening of levator ani muscle groups through which the urethra, vagina and rectum course
- orifice through which pelvic organ prolapse occurs
Supporting Structures

- **Fascia**
  - Poorly seen with MRI; defects inferred
  - Deepest layer

- **Anterior** – pubocervical fascia (pubis, bladder and anterior vaginal wall)

- **Middle** – parametrium (cardinal and uterosacral ligaments, supports body of uterus) and paracolpium (bridges vagina to bladder and rectum); posteriorly, condensation to form rectovaginal fascia

- **Posterior** – arcus tendineus (anchor for levator ani muscles)
Supporting Structures

Muscles
- More superficial than fascia
- Well-seen with MRI

Posterior
- levator ani (components: *puborectalis*, *pubococcygeus* and *iliococcygeus*)
  - *puborectalis* (posterior sling around rectum; opposes the orifices in the pelvic outlet, elevate bladder neck and compress against pubic symphysis)
  - *iliococcygeus* (horizontal orientation, laterally reaches arcus tendineus; posteriorly condenses to firm midline raphe = levator plate) – important physical barrier
Supporting Structures

- **Perineal Membrane/Body**
  - inferior to levator ani
  - separates vagina and rectum
  - dense structure

- **insertion of 5 muscles**
  - deep transverse perineal muscle
  - superficial muscles of perineal membrane
  - external urethral sphincter
  - external anal sphincter
  - levator ani

- prevents expansion of urogenital hiatus

- can be damaged by episiotomy
Results of Weakness in the Compartments

- Anterior: prolapse of urinary bladder → cystocele → urinary incontinence
- Middle: Prolapse of cervix and uterus; apical prolapse (hysterectomy)
- Posterior: rectocele; enterocoele
Surgical Treatments

- Uncomplicated stress incontinence – retropubic urethropexy
- Hypermobility/rotation of urethra and bladder – pubovaginal sling
- Cystocele – Birch colposuspension (suspends lateral bladder from pelvic side walls) +/- paravaginal fascial repair
- Uterine (or vault) prolapse – hysterectomy and uterosacral suspension +/- mesh
- Enterocoele – rectovaginal fascia reapproximation/culdoplasty
- Rectocele – posterior colporrhaphy
- Recurrence in 10-30%
Urologic Assessment

- **History**
  - frequency, urgency, urge and stress incontinence, stream, difficulty emptying, symptom severity, neurologic disorder, prior urinary tract surgery, prolapse in women

- **Physical Exam**
  - prolapse, pelvic floor strength (women); DRE (men); perineal neurologic exam

- **Bladder Diary**
  - frequency, volume, incontinence episodes

- **Urinalysis** - MSU

- **Pad Weight** – may be helpful
Imaging Pathways

- Imaging asymptomatic women not helpful

- In **symptomatic** women, physical examination essential for diagnosing pelvic organ prolapse

- **Mild** symptoms (mild urinary incontinence)
  - urodynamic studies

- **Moderate/severe** symptoms (severe urinary incontinence, fecal incontinence, procidentia, complex pelvic floor disorder)
  - Physical exam may be inadequate (poor specificity and sensitivity)
  - If urinary incontinence, often have prolapse in other compartments requiring repair
  - Requires accurate assessment of compartments involved for surgical planning
Traditional methods
- Urodynamics
- Voiding cystourethrography
- Ultrasound of bladder neck and anal sphincter
- Fluoroscopic cystocolpodefecography

MRI
- Relatively newer technique
- Visualises all 3 compartments
- Direct visualisation of support muscles and organs
- No ionizing radiation; non-invasive
- Definition of contents of enterocoeles
Urodynamics

- Non-invasive
  - free uroflowmetry and post void volume
- Invasive
  - catheterization
  - filling cystometry and pressure flow studies
- May be combined with imaging
  - Fluoroscopic urodynamics/videourodynamics
    - Bladder filled with contrast
  - Ultrasound – prolapse, bladder neck hypermobility
MRI Technique

- supine or lateral decubitus
- patient preparation: enema
- partial voiding before scan
- external coil
- gel in vagina 20 mL and rectum 60-120 mL
- fast, large FOV T2 weighted imaging in midsagittal plane
  - Neutral, bearing up and straining cine loop
  - repeated after evacuation in patients with rectocele
- small field of view, axial high resolution, T2 weighted images
  - muscles, fascia, anatomy
- approximately 20 minutes total scan time
Interpretation of Imaging Findings

- **Important Radiologic Landmarks (Midsagittal)**
- **Pubococcygeal Line**
  - Joins inferior aspect of pubic symphysis to last horizontal sacrococcygeal joint
- **Levator Plate**
  - Normally parallel to pubococcygeal line
- **H Line and M Lines**
- **H Line**: Distance from inferior PS to posterior anorectal junction (width of hiatus) → normal < 5 cm

- **M Line**: Perpendicular from PC line to H line (descent of hiatus) → normal < 2 cm

- No data on relationship of degree of prolapse (on measurements) and severity of symptoms

- Other normal findings
  - Vagina: normal butterfly configuration, well-centred
  - Pelvic floor muscles: symmetry and integrity
Interpretation of Imaging Findings: Anterior Compartment

- Urinary Incontinence
  - stress
    - involuntary loss with increased intra-abdominal pressure
  - urge
    - detrusor instability or damage to nervous supply
  - overflow
    - small volume leakage when bladder over distended
    - bladder muscle weakness
    - neurogenic bladder, chronic outflow tract obstruction
    - men > women

- Assessment
  - multidisciplinary (urologist, urogynaecologist, psychologist, physical therapist, radiologist)

- Treatment
  - conservative (pelvic floor exercise, pessary, lifestyle modification)
  - surgery: (Burch colposuspension – cystocele)
Interpretation of Imaging Findings: Anterior Compartment

Supporting Structures

- Fascia: 3 groups of ligaments (periurethral, paraurethral, pubourethral)
- Anterior Vaginal Wall (apposition to distal 2/3 urethra)
- Together with pelvic diaphragm: Hammock-like support to urethra
  - Bladder elevation
  - Urethral elongation

Abnormal Imaging Findings

- > 1 cm vertical distance from bladder neck to PC line (during straining)
- Cystocele
- Loss of normal vaginal butterfly shape → indicates disruption of paravaginal ligaments → loss of hammock support
- Repair of cystocele and fascia
Interpretation of Imaging Findings: Middle Compartment

- **Contents**
  - uterus, cervix, vagina

- **Supporting Structures**
  - Vaginal 3 levels
    - level 1: cephalic 2-3cm (parametrium and paracolpium support to side wall)
    - level 2: between 1 and 3 (arcus tendineus)
    - level 3: hymen ring to 2-3 cm cephalad (fused anteriorly to urethra, laterally to levator ani and posteriorly to perineal body)
Interpretation of Imaging Findings: Middle Compartment

- **Effects of Weakened Support Structures**
  - paracolpium: hysterectomy → apical prolapse, (>1cm above PC line is normal at strain)
  - cardinal or uterosacral ligaments → descent of uterus, cervix, vagina
  - H and M lines elongated
  - Increased transverse dimension of hiatus on axial images; flattened vagina, asymmetric levator muscles, convex morphology; normal < 4.5 cm
  - Fibroid may underestimate effect
Interpretation of Imaging Findings: Posterior Compartment

- **Perineal Body**
  - fused to distal vagina, separates from rectum
  - important anchor for muscles and ligaments of urogenital diaphragm

- **Posterior Vaginal Bulge**
  - commonest cause = anterior rectocele
  - due to weakness of rectovaginal fascia
Interpretation of Imaging Findings: Posterior Compartment

- caudal angulation of levator plate >10 degrees from PC line \(\Rightarrow\) pelvic floor weakness

- anterior rectal bulge > 3cm (measured from anal canal to tip of rectocele) \(\Rightarrow\) anterior rectocele

- sigmoidocele

- rectal intussusception

- enterocoele (small bowel) and peritoneocele (peritoneal fat)
  - deficiency of iliococcygeus \(\Rightarrow\) widening of rectovaginal space
  - descent of small bowel > 2 cm
  - normal rectovaginal space apposed in lower 2/3
    - hysterectomy may damage

- Caveat:
  - Large enterocoele may mask co-existing cystocele or rectocele and vice versa \(\Rightarrow\) reassess after treatment
Summary

- Pelvic floor weakness is a common problem in women over 50 years old
- Symptomatic women often have multiple compartments involved
- MRI
  - excellent for assessing women with moderate/severe symptoms and for surgical planning and preventing recurrence
  - provides an anatomic and functional information, is relatively quick and without radiation exposure
  - requires correlation with severity of symptoms
References

- MRI of Pelvic Floor Dysfunction: Review (Law and Fielding, AJR 2008)
- Practical MR Imaging of Female Pelvic Floor Weakness (Fielding, Radiographics, 2002)
- Urodynamics (McKertich, AFP 2011)