Pelvic Physical Therapy Distance Journal Club
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Melissa Eagleton

Lateral abdominal muscle thickness during breathing maneuvers in women with and without stress urinary incontinence. Tavahomi M, Dadgoo M, Vasaghi-Gharamaleki B, et al. Int Urogyn J. 2023;Feb 22:1-8. Doi:10.1007/s00192-023-05458-9.

Introduction:

- Pelvic floor muscles work in synergy with other muscles of the abdominal wall during activities that increase IAP.
- A 2019 systematic review found that healthy individuals had co-contraction of TrA and PFM during abdominal draw-in and voluntary PFC but patients with SUI did not.
- Other studies have observed increased thickness of external obliques and decreased thickness of internal obliques and TrA during voluntary abdominal contraction in patients with UI.
- Abdominal muscles contract during rapid forced expiration (cough, sneeze) to increase IAP and assist with pushing air out. During inhalation, diaphragm contracts and abdominals remain relaxed. Exhalation occurs as the diaphragm rebounds in during relaxed breathing.

Aim/Primary Aim: to investigate abdominal muscle thickness using US during different breathing phases (end of deep inspiration, end of deep expiration, and expiratory phase of cough) between women with and without stress urinary incontinence.

Study Design/Study Format: Case-control format using a sample of convenience

Methods:

- Inclusion criteria: patients diagnosed with and chief complaint of SUI at urogyn clinics of 2 hospitals; healthy controls were employees recruited from the same hospitals without UI Sx and score of 0 on ICIQ-UI SF. All were females aged 20-55, non-menopausal.
- Exclusion criteria: BMI >30kg/m^2, Hx of C-section, pregnant or delivered in previous 6 months, DM, NS problems, POP > grade 2, hysterectomy, pelvic floor surgery in previous 6 months, taking meds related to UI, breathing disorders, lung damage from coronavirus infection, smoking, professional athlete
- Lateral muscle thickness measurements of TrA, EO, and IO were collected using a linear US transducer by a single PT supervised by a sonographer. The procedure was standardized regarding transducer position, pressure, and reference landmarks.
- Cine-mode US was used to view phasic changes in muscle thickness.
    - Quiet breathing was observed without pt knowing
    - Subjects were asked to perform 3 reps of each maximum deep breathing and coughing in random order
        - 3-minute rest between each maneuver, 30 sec rest between each rep to prevent fatigue

        - The mean of 3 muscle thickness measurements was obtained at rest and at each of the phases noted above
        - Measurements of thickness at rest were used in calculations to eliminate the effects of individual differences
- 10 healthy women assessed to determine test- retest reliability (ICC) - unclear if this was performed as a pre-trial or part of the study
- Results were analyzed to make comparisons for each muscle between healthy and SUI subjects, and within each of the breathing maneuvers.

Results:

- Sample size calculated at 32 but was increased to 42 to account for attrition. 20 Healthy women and 17 with SUI were assessed.
- Excellent reliability (ICC >0.75) for measurement of each muscle in all breathing maneuvers.
- Results were consistent with other studies and agreed with hypotheses.
    - Healthy individuals had significantly greater **change** in thickness (more muscle contraction) of TrA during deep expiration and coughing compared to women with SUI.
    - Women with SUI had a significantly greater IO thickness **change** at end inspiration.
    - Women with SUI had a significantly greater EO thickness **change** at end expiration.
    - No difference was observed in the thickness change of the external obliques with cough between groups

Discussion:

- During deep expiration in healthy individuals**,** it has been proposed that TrA contraction could pull in the abdominal wall. This contraction would increase IAP resulting in stiffening of the PFM, increasing urethral pressure and closure (continence control). In SUI patients, inadequate contraction of TrA would allow the abdominal wall to bulge, forcing the PFM down, decreasing urethral pressure and resulting in leaking.
- No difference in EO thickness change with cough between groups; coughing is a rapid maneuver so increased elastic recoil of the lungs and ribs may lower need for EO contraction.
- Authors expected thickness change of all 3 muscles during deep inspiration to be higher in women with SUI but only found significant increase in IO. Their proposed explanation is that fiber and attachment orientation acts directly on lower ribcage; contraction during inspiration could lead to increase in IAP and overload PFM, resulting in SUI.

Strengths:

- Phasic changes during breathing were measured while using cine mode of US which allowed selection of exact frames with least and most thickness values during each phase of breathing. This also prevented collection of data during breath holding or abdominal bracing.
- Standardization of measurements allows for repeatability, single assessor/ supervised.

Weaknesses:

- Sample of convenience limits generalizability.
- Had to record measurements at max inspiration, expiration, and cough due to inability to control volume of respiration during normal breathing maneuvers.
- Authors never really defined significance of “thickness change” in terms of what was happening to the muscle – contraction, lengthening, atrophy, weakness? There were also sections of the article where they use “thickness” and “thickness change” interchangeably in the same paragraphs.
- Did not specifically describe or standardize breathing techniques that were used.

Clinical Application

- Study results suggest that retraining of the abdominal muscles during breathing plays an important role in rehab of SUI (BFB, RTUS).
- Understanding the function of the abdominals and diaphragm during breathing maneuvers in patients with UI may help with exercise prescription for abdominal muscle training.

Discussion questions:

1. Why would IO thickness change increase with deep inspiration if abs are supposed to be passive/ lengthening?
2. Based on study results, what might we observe in the breathing patterns, posture, anatomy of women with SUI?
3. How can we use the results of this study to influence our treatment interventions in patients with SUI?

Other References:
https://masserypt.com/course-videos/

Abdominal and pelvic floor activity related to respiratory diaphragmatic activity in subjects with and without non-specific low back pain. Sicilia-Gomez D, Fernandez-Carnero S, Martin-Perez A, et al. Diagnostics. 2002;12:2530. Doi:10.3390/diagnostics12102530.

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