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Transabdominal ultrasound imaging in the assessment of bladder base displacement: a systematic scoping review for physiotherapy purposes

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 March 2024 and was last updated on 13 March 2024.

INTRODUCTION

Review question / Objective This scoping review aims to identify publications on pelvic floor muscle function assessment using transabdominal ultrasound imaging (TAUSI) for physiotherapy purposes. Considering the Population/Concept/Context (PCC) framework our scoping review concerns healthy human adults (including women in various stages after childbirth) or human adults with different types of pelvic floor disorders or pelvic pain or low back pain who had undergone transabdominal ultrasound imaging of the bladder base in resting position and during pelvic floor muscle (PFM) contraction, increases in intra-abdominal pressure, or other maneuvers for the assessment of bladder base displacement. Using this framework we also aim to present TAUSI procedure in the assessment of bladder base before and after the patient's education about

pelvic floor muscle (PFM) function, proper PFM contraction, physical exercise/training of lumbopelvic-hip complex with ultrasound biofeedback. Based on systematically mapped peer-reviewed studies, we aim to perform data extraction and synthesis of specific aspects of the transabdominal ultrasound imaging and measurement procedure and discuss their similarities and differences. Based on data extraction, analysis, and presentation of results in the scoping review, the authors plan to get acquainted with the TAUSI and measurement procedure, parameters, and anatomical landmarks used to evaluate bladder base in the mid-sagittal and transverse plane during PFM activity. Other purposes of the scoping review is to make an attempt to formulate guidelines to standardize TAUS imaging and measurement procedure and to identify and analyse knowledge gaps. A narrative summary addressing the scoping review's

objective might be considered in future physiotherapy studies and practice.

Background There is a growing interest in ultrasound imaging (USI) in physiotherapy. Current applications of US in musculoskeletal imaging generally fall into two different areas of musculoskeletal diagnostic imaging, and rehabilitative USI (RUSI) [1], which also applies to physiotherapy. Ultrasound imaging involves the assessment of pelvic floor muscles morphology (evaluation of muscle structure) and function [2]. Ultrasonographic evaluation can be performed with an ultrasound transducer overlying the abdominal wall (TAUS), whereby bladder displacement resulting from PFM voluntary and automatic contraction, increases in intra-abdominal pressure, bearing down or other maneuvers is assessed.

As TAUS imaging is a safe and non-invasive measurement procedure, it can be recommended for physiotherapy practice [3]. TAUSI can be used as a biofeedback option for re-education and rehabilitation of PFMs in postpartum patients with stress urinary incontinence (SUI) [4]. Access to real-time visual information about the elevation of the urinary bladder as a result of the pelvic floor muscle contraction improves the effectiveness of PFM training with biofeedback [5]. The usefulness of transabdominal ultrasound examination during pelvic floor muscle and abdominal exercises or other maneuvers in assessing the displacement of the urinary bladder base was described [6].

The scoping review will be conducted to systematically map the scientific papers describing the TAUSI and measurement procedures in the assessment of PFM function and to identify the strengths and limitations of the procedures.

The following research question was formulated: What is known from the scientific literature about the TAUSI procedure to measure the movement of the bladder base during pelvic floor muscle contraction or other maneuvers for physiotherapy purposes?

Rationale Transabdominal US measurements help evaluate the displacement of the bladder base resulting from the activity of the pelvic floor muscles (voluntary and automatic contraction), increases in intra-abdominal pressure by bearing down, or other maneuvers. However, TAUSI-based measurements for physiotherapy purposes have yet to be standardized. Difficulty in identifying bony landmarks serving as reference points for measurements compromises the ability to establish normative displacement values [7]. Discrepancies between the study measurement protocols, including patient body position,

transducer location, orientation, inward pressure, or breathing phase during image capturing, also poses a problem. Such differences may influence study outcomes and cause difficulties in the comparison of findings between research centers [1,2]. Therefore, systematic mapping of physiotherapy-related studies that involve transabdominal ultrasound imaging to evaluate the displacement of the bladder base is needed to compare and discuss the specific aspects of the measurement procedures conducted in various research centers.

METHODS

Strategy of data synthesis Two reviewers with experience in systematic review methodology will independently search the databases for potentially relevant publications using predefined keywords. The search keywords include: ultrasonography; ultrasound imaging; transabdominal ultrasound; pelvic floor; pelvic floor muscle; abdominal muscles; bladder base.

For PubMed, the preliminary search strategy is as follows:

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((ultrasonography[MeSH Terms]) OR (diagnostic ultrasound[MeSH Terms]) OR (ultrasonography[Title/Abstract]) OR (ultrasonography[Text word]) OR (diagnostic ultrasound[Title/Abstract]) OR (diagnostic ultrasound[Text word]) AND (ultrasound imaging[Title/Abstract] OR (transabdominal[Title/Abstract] OR (transabdominal ultrasound[Title/Abstract] OR (transabdominal ultrasound[Text word]) AND (bladder base[Title/Abstract] OR disorders pelvic floor[MeSH Terms] OR pelvic floor[MeSH Terms] OR pelvic floor[Title/Abstract] OR pelvic floor[Text word] OR pelvic floor muscle*[Title/Abstract] OR abdominal muscles[MeSH Terms] OR abdominal muscles[Title/Abstract] OR abdomi* muscles[Title/Abstract]))))
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MEDLINE (PubMed, EBSCOHost), EMBASE (Elsevier), and Web of Science databases will be searched. No limit will be applied to the publication date. To minimize the risk of omitting relevant sources, strategies to explore grey literature (i.e. Google Scholar) will be implemented.

The reference lists of studies meeting the inclusion criteria in the second, i.e., full-text screening level, will be searched to identify additional relevant studies. Two researchers will perform the screening independently.

Eligibility criteria Eligibility criteria are based on the PCC framework:

Inclusion criteria:

Study design: Full-text of peer-reviewed original research articles written in English (randomized controlled trials, clinical trials, case reports, case series, observational, case-control, cross-sectional studies)

Population:

Healthy human adults (among others, women after childbirth) or human adults with different types of pelvic floor disorders, pelvic or low back pain

Concept:

Transabdominal ultrasound imaging (TAUSI) of the bladder base position at rest and during pelvic floor muscle (PFM) contraction, increases in intra-abdominal pressure while bearing down, or other maneuvers for the assessing of bladder base displacement (detailed procedure description)

Context: Transabdominal ultrasound imaging (TAUSI) of the urinary bladder and measurement procedure for physiotherapy purposes:

- in the assessment of the initial position of the bladder base with the PFM at rest, of the bladder base displacement during PFM contraction, increases in intra-abdominal pressure while bearing down or during other maneuvers

- before and after patient's education about PFM function, proper PFM contraction, or physical exercise/training of lumbo-pelvic-hip complex with biofeedback

Exclusion criteria:

Study design: Only abstract form, conference proceeding, letter, review, meta-analysis, non-clinical assessment, poster.

Population: Humans examined/diagnosed for genitourinary, excretory, or pelvic area cancer, pregnant women, human infants, children and adolescents, non-humans, cadaver studies

Concept:

Transabdominal ultrasound imaging (TAUSI) for reasons other than the displacement of the bladder base

Context:

Transperineal (perineal) or transrectal (endoanal) or transvaginal (endovaginal) or introital ultrasonography imaging only

Intraoperative TAUS imaging only

Diagnostic ultrasound unrelated to:

- a. bladder base displacement
 - b. bladder base imaging before and after patient's education about PFM function, proper PFM contraction, and physical exercise/training of lumbo-pelvic-hip complex with biofeedback
 - c. physiotherapy or pelvic floor disorders or pelvic pain
 - d. pelvic floor evaluation
- Ultrasound diagnostics related to the assessment of the uterus, ovaries, oviducts/ adnexa uteri

- TAUS imaging / ultrasound diagnosis related to testing reliability and accuracy of ultrasound measurements

- Tomographic ultrasound imaging

- Elastography, ultrasound.

Source of evidence screening and selection

The selection of literature search results will be carried out in two stages using the Microsoft Forms software (Office 365). The inclusion criteria will be imported into the forms, which will be developed a priori and will be used during level 1 screening of citations (Form I on titles and abstracts screening) and during level 2 screening (Form II on full-text article screening). These forms and the explanation and elaboration documents will be developed by two review leads. Pilot tests of each form will be conducted by these two reviewers independently on a random sample of 10% of the retrieved citations prior to commencing screening.

The aim of the pilot tests will be to establish consistency in using eligibility criteria between the reviewers. If investigators do not reach sufficient agreement on publication inclusion and exclusion, some changes will be made to the questions in the forms and another form testing will be conducted.

Subsequently, two reviewers will screen titles and abstracts for inclusion, independently. Two reviewers will screen the full text of potentially relevant articles based on inclusion and exclusion criteria. Any discrepancies between the reviewers will be resolved by the third reviewer.

Data management

A draft of the charting table will be developed by two review leads and they will determine which extracts should be copied and pasted to the table (to include the key information relevant to the review question). Two independent reviewers will first perform a calibration exercise with a random sample of 10% of the included articles and make the draft of the data-charting tables. The results of the calibration exercise will be discussed and the data-charting form will be updated in an iterative process. Once consensus is reached, two reviewers will independently extract data from all included studies. The result of this stage will be the grouping of the extracts for summary purposes.

Reporting results / Analysis of the evidence

Synthesis of the results describing the details of the transabdominal ultrasound imaging and measurement procedure will be presented in the narrative summary. It will contain the following data items: the examinee's body position during the assessment of PFM activity, specific muscle activation/task during the examination, bladder

filling, transducer location, characteristics of the ultrasonographic scanner and transducer, selection of anatomical landmarks, the number of images taken for the measurement, the examiner's profession and experience, the image processing and measurement methods.

Presentation of the results The results will be presented in tables as summarized extracts. The tables will include summarized data items (concerning specific aspects of the TAUSI and measurement procedure) of all included publications. The results synthesis will be made in the narrative format.

Language restriction Yes. Only papers published in English will be included.

Country(ies) involved Polska, Czechia. Academy of Physical Education, Katowice. Poland Medical University of Silesia, Katowice. Poland Medical University of Silesia, Zabrze, Poland. Charles University and University Hospital Motol in Prague, Czech Republic.

Keywords Ultrasonography; ultrasound imaging; diagnostic ultrasound; transabdominal ultrasound; bladder base; pelvic floor; pelvic floor muscle; abdominal muscles.

Dissemination plans We are planning to submit the scoping review to an international peer-reviewed journal.

Contributions of each author

Author 1 - Daria Chmielewska - Author 1: conception and design of the scoping review, data collection, management, synthesis, and interpretation, review coordination, writing the protocol and manuscript.

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Author 5 - Agnieszka Opala-Berdzik - Author 5: conception and design of the scoping review; data collection, management, synthesis, and interpretation; writing the protocol, critical revision of the manuscript, writing the manuscript.

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