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UTILITY OF TRANSPERINEAL ULTRASOUND IN THE EVALUATION OF STRESS URINARY INCONTINENCE

Radio-Diagnosis

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ABSTRACT

Background: Stress urinary incontinence (SUI) is the involuntary leakage of urine during activities that increase intra-abdominal pressure, such as coughing, sneezing, or physical exertion. It is a common condition among multiparous and postmenopausal women and can significantly impair physical, psychological, and social well-being. Transperineal ultrasound (TPUS) is a noninvasive imaging modality that provides real-time assessment of pelvic floor structures and may improve the evaluation of SUI. **Objective:**To assess the utility of TPUS in diagnosing SUI by evaluating pelvic floor dynamics, urethral mobility, and associated pelvic floor abnormalities. **Methods:** This analytical cross-sectional case-control study was conducted at J.J.M. Medical College, Davangere, between March 2024 and September 2025. Sixty women aged 25–65 years were enrolled, including 30 clinically diagnosed SUI cases and 30 continent controls. All participants underwent clinical assessment and TPUS examination using a Voluson E6 ultrasound system. Parameters evaluated included alpha angle, beta angle, and rotational mobility at rest and during straining. Statistical analysis was performed using SPSS version 25.0, with $p<0.05$ considered statistically significant.**Results:** SUI was significantly associated with higher parity (≥2), previous vaginal delivery, and postmenopausal status ($p<0.05$). Women with SUI demonstrated significantly greater alpha angles, beta angles, and rotational mobility compared with controls. Anterior compartment prolapse (cystocele) was also significantly more common among SUI cases. **Conclusion:** TPUS is a reliable, noninvasive, and effective tool for assessing pelvic floor dysfunction in women with SUI. It provides objective evaluation of urethral hypermobility and associated pelvic abnormalities, facilitating accurate diagnosis and supporting clinical decision-making.

KEYWORDS

Stress Urinary Incontinence, Transperineal Ultrasound, Pelvic Floor, Bladder Neck, Urethral Hypermobility, Diagnostic Imaging.

INTRODUCTION

Stress urinary incontinence (SUI) is defined as the involuntary leakage of urine during activities that increase intra-abdominal pressure, such as coughing, sneezing, laughing, or physical exertion. It is the most common type of urinary incontinence among women and represents a significant public health problem. The condition is particularly prevalent among multiparous and postmenopausal women due to pelvic floor muscle weakness, connective tissue damage, and hormonal changes.

Beyond physical symptoms, SUI negatively affects quality of life by causing embarrassment, anxiety, social withdrawal, and reduced participation in daily activities. Despite its high prevalence, many women do not seek medical attention because of stigma and lack of awareness. Accurate assessment of pelvic floor dysfunction is essential for diagnosis and management. Conventional methods include clinical examination and urodynamic testing; however, these techniques may be invasive and provide limited anatomical information. Transperineal ultrasound (TPUS) has emerged as a non-invasive, readily available imaging modality that enables real-time visualization of pelvic floor structures. It allows assessment of bladder neck position, urethral mobility, and pelvic organ prolapse during rest and straining.

TPUS permits objective measurement of parameters such as the á-angle (urethropelvic angle), â-angle (posterior urethrovesical angle), and their rotational changes during Valsalva maneuver. These measurements help identify urethral hypermobility, a key mechanism underlying SUI. TPUS can also detect associated pelvic floor abnormalities, including cystocele and uterovaginal prolapse. Owing to its safety, affordability, and accessibility, TPUS has become increasingly valuable in the evaluation of female pelvic floor disorders.

This study aimed to evaluate the utility of TPUS in women with SUI and to correlate sonographic findings with clinical and obstetric risk factors.

Materials and Methods

Study Design and Setting

This analytical cross-sectional case-control study was conducted in the Department of Radiodiagnosis, J.J.M. Medical College, Davangere, including Bapuji Hospital, Chigateri District Hospital, and Women and Children's Hospital, from March 2024 to September 2025.

Study Population

A total of 60 women aged 25–65 years were included. Thirty women with clinically diagnosed SUI constituted the case group, while 30 continent women served as controls.

Inclusion and Exclusion Criteria

Women aged 25–65 years with symptoms of involuntary urine leakage during exertion and willing to participate were included. Exclusion criteria comprised procidentia, recent pelvic surgery, active urinary or pelvic infection, inability to perform the Valsalva maneuver, and refusal to provide consent.

Ultrasound Technique

All participants underwent TPUS using a Voluson E6 ultrasound system equipped with a 3–5 MHz convex array transducer. Examinations were performed in the lithotomy position with a partially filled bladder (100–120 mL).

The transducer was placed in the interlabial region and imaging was obtained in midsagittal and axial planes at rest and during straining. Structures visualized included the urinary bladder, urethra, vagina, uterus, and anorectal junction.

Parameters Assessed

The following parameters were measured:

1. Alpha angle
2. Beta angle
3. Rotational change in alpha angle
4. Rotational change in beta angle
5. Presence of pelvic organ prolapse

Statistical Analysis

Data were analyzed using SPSS version 25.0. Quantitative variables were expressed as mean ± standard deviation and compared using Student's t-test. Qualitative variables were analyzed using Chi-square or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

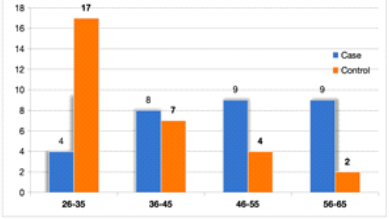

Figure 1: Distribution of participants according to age groups.

The mean age of women with SUI was 47.63 ± 10.52 years, compared with 37.37 ± 9.84 years among controls. The highest proportion of cases belonged to the 56–65-year age group, whereas controls were predominantly younger.

Parity

Parity demonstrated a significant association with SUI. Most controls were primiparous (56.67%), while the majority of cases had parity ≥2. Overall, 93.33% of cases had parity ≥2 compared with 30% of controls (p=0.001), indicating a strong relationship between increasing parity and SUI.

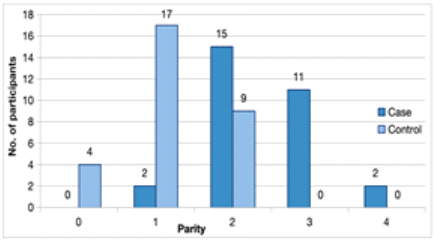

Figure 2: Distribution of participants according to parity.

Mode of Delivery

A significant association was observed between vaginal delivery and SUI. Among cases, 73.33% had a history of vaginal delivery compared with 33.33% of controls. Cesarean delivery was more common among controls (p=0.004).

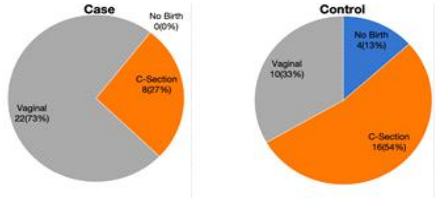

Figure 3: Comparision of mode of delivery among cases and control

Menopausal Status

Menopause was significantly associated with SUI. Half of the women in the case group were postmenopausal compared with only 20% of controls (p=0.034).

Alpha-Angle Measurements

The mean á-angle at rest was significantly higher among cases (62.06°) than controls (45.30°). During straining, the á-angle increased to 79.83° in cases compared with 50.74° in controls. The rotational change (Äá) was also significantly greater in cases (17.67° vs. 5.04°, p<0.001).

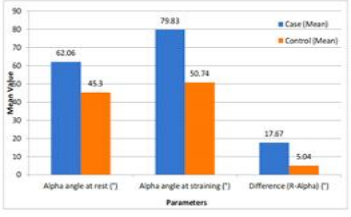

Figure 4: Comparison of alpha angle at rest straining and difference (R-Alpha) parameters between case and control groups.

Beta-Angle Measurements

The Beta angle was significantly increased in women with SUI. Mean Beta angle values at rest were 113.28° in cases and 96.39° in controls. During straining, values increased to 139.33° and 103.04°, respectively. The rotational change in beta angle was significantly greater among cases (26.11° vs. 6.65°, p<0.001).

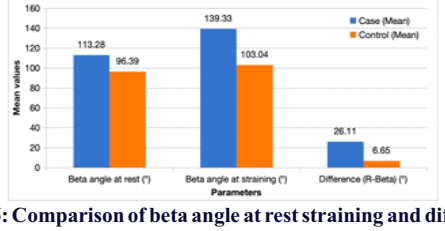

Figure 5: Comparison of beta angle at rest straining and difference (R-beta) parameters between case and control groups.

Pelvic Organ Prolapse

Anterior compartment prolapse (cystocele) was identified in 63.33% of cases and was absent among controls. Uterovaginal descent was observed in 20% of cases, while rectocele was uncommon.

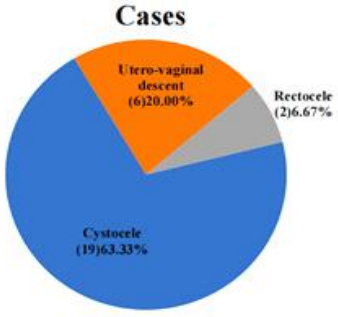

Figure 6: Distribution of compartment descent among Cases

Representative cases:

Case 1:

A 48-year-old multiparous female (para 2) presented with symptoms consistent with stress urinary incontinence. She had a history of two prior vaginal deliveries. The patient had not yet attained menopause at the time of presentation.

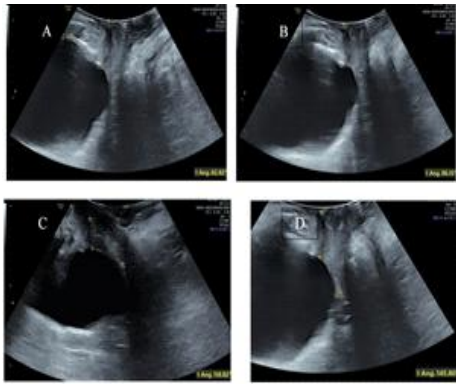

Figure 7: Transperineal ultrasonography (USG) in the midsagittal section. (A) Alpha angle at rest (62°). (B) Alpha angle during strain (86°). Beta angle at rest (118°). (D) Beta angle during strain (145°).

Case 2: A 58-year-old multiparous female (para 3) presented with stress urinary incontinence. She had a history of prior vaginal delivery. The patient had attained menopause at the time of presentation.

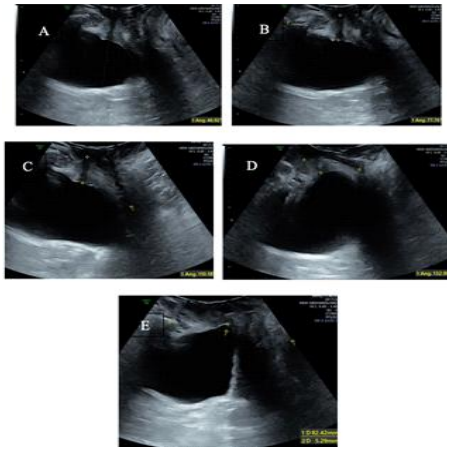

Figure 8: Transperineal ultrasonography (USG) in the midsagittal section. (A) Alpha angle at rest (46°). (B) Alpha angle during strain (77°). Beta angle at rest (110°). (D) Beta angle during strain (132°). (E) The bladder descent during strain measured 5.29 mm from the reference line drawn between the pubic symphysis and anorectal junction, indicating cystocele.

Case 3: A 61-year-old multiparous female (para 2) presented with

stress urinary incontinence. She had a history of two prior vaginal deliveries. The patient had attained menopause at the time of presentation.

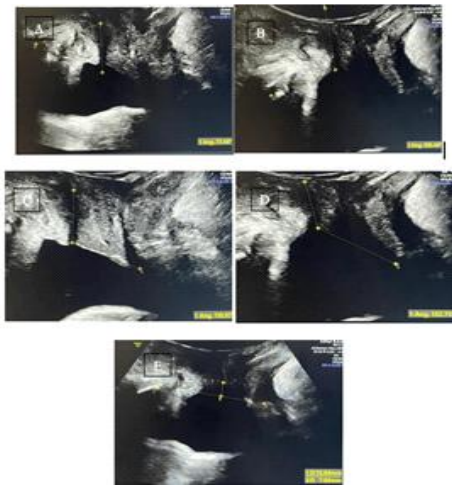

Figure 9: Transperineal ultrasonography (USG) in the midsagittal section. (A) Alpha angle at rest (73°). (B) Alpha angle during strain (102°). Beta angle at rest (110°). (D) Beta angle during strain (132°). (E) The bladder descent during strain measured 7.89 mm from the reference line drawn between the pubic symphysis and anorectal junction, indicating cystocele.

DISCUSSION

This study demonstrated the utility of transperineal ultrasound (TPUS) in evaluating women with stress urinary incontinence (SUI). Women with SUI were older and more likely to have higher parity, previous vaginal delivery, and postmenopausal status than continent controls.

Higher parity was strongly associated with SUI, supporting the role of repeated childbirth in pelvic floor weakening and urethral hypermobility. Vaginal delivery was significantly more common among cases, likely reflecting pelvic floor and connective tissue injury sustained during childbirth. Menopause was also associated with SUI, possibly due to estrogen deficiency and age-related tissue atrophy.

TPUS findings demonstrated significantly higher alpha and beta angle measurements in women with SUI both at rest and during straining. Rotational changes of these angles were also significantly greater among cases, indicating increased urethral mobility and impaired pelvic floor support. Dynamic assessment during Valsalva maneuver was particularly useful in demonstrating functional abnormalities.

Anterior compartment prolapse (cystocele) was identified in a majority of women with SUI and was absent among controls, highlighting the close relationship between anterior vaginal wall support defects and urinary incontinence. Posterior compartment abnormalities were uncommon.

These findings are consistent with previous studies demonstrating that TPUS is a reliable and non-invasive method for evaluating bladder neck mobility, urethral rotation, and pelvic organ prolapse. Compared with invasive investigations, TPUS is inexpensive, widely available, well tolerated, and provides real-time assessment of pelvic floor function.

Although limited by a relatively small sample size and single-center design, the study supports the use of TPUS as a valuable adjunct in the diagnostic evaluation of women with SUI.

CONCLUSIONS

Stress urinary incontinence is strongly associated with increasing age, higher parity, vaginal delivery, and menopausal status. Women with SUI demonstrated significantly higher alpha and beta angle measurements, greater rotational changes during straining, and increased urethral mobility compared with continent controls.

Anterior compartment prolapse, particularly cystocele, was frequently associated with SUI and may contribute to bladder neck instability. Dynamic TPUS assessment effectively identified these abnormalities and provided objective evidence of pelvic floor dysfunction.

Transperineal ultrasound is a reliable, non-invasive, and cost-effective imaging modality for the evaluation of stress urinary incontinence. Its ability to assess urethral mobility, bladder neck descent, and associated pelvic organ prolapse makes it a valuable adjunct to clinical examination. TPUS may facilitate early diagnosis, improve risk stratification, and support appropriate management decisions in women with SUI.

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