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The Use of Trans-abdominal Ultrasound in Assessment of The Lower Uterine Segment Thickness in Patients with Previous Cesarean Section: Meta-Analysis

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ABSTRACT

Background: The rising global Cesarean section (CS) rate has increased interest in vaginal birth after Cesarean (VBAC) due to its benefits over elective repeated CS.

Aim: This study aimed to evaluate the use of trans-abdominal ultrasound (TAUS) in assessing lower uterine segment (LUS) thickness in females with previous CS, highlighting its predictive value and potential clinical decision-making role.

Methods: We conducted a thorough search on Google Scholar, PubMed, Embase, & Cochrane Library. The investigation utilized both textual terms and medical subject titles, such as TAUS, CS, LUS and trial of labour (TOL) across Medline, Embase, ClinicalTrials.gov and Cochrane Library. In addition, we conducted a thorough search on ClinicalTrials.gov and examined the references cited in selected publications and reviews to discover more relevant observational research.

Results: Regarding elective repeat CS, TAUS measurements correlated with delivery outcomes and LUS thickness, with cut-off values varying from 1.5 to 4.05 millimeters. The pooled analysis exhibited a relative risk (RR) of 0.7 (95% confidence interval: 0.4, 0.9), with high heterogeneity (Chi-p <0.001, I^2 = 100%). Concerning uterine dehiscence & rupture, an association was found between thin LUS and uterine dehiscence (7 studies) and uterine rupture (1 study). An RR of 0.09 (95% confidence interval: 0.04, 0.15) for dehiscence and 0.003 (95% confidence interval: -0.001, 0.006) for rupture. Major heterogeneity for dehiscence (Chi-p <0.001, I^2 = 100%) and homogeneity for rupture (Chi-p <0.9, I^2 = 0%).

Conclusion: TAUS is a valuable non-invasive tool for assessing LUS thickness in females with previous CS, thereby influencing clinical decisions.

Keywords: TAUS, VBAC, Ultrasound.

INTRODUCTION

The rate of CS has consistently risen globally [(1)]. Vaginal birth following CS is an increasingly preferred technique of delivery over elective repeat Cesarean delivery due to its lower cost and greater efficacy [(2)]. Failed vaginal birth following CS presents greater probabilities of uterine rupture and infectious morbidity compared to effective vaginal birth following CS or elective repeat CS [(3)].

The accurate assessment of uterine rupture risk is crucial for managing subsequent pregnancies following a prior Cesarean delivery. Multiple predictive score techniques were evaluated for forecasting successful VBAC depending on patients' clinical features, however none proved to be entirely predictive [(4)].

The assessment of the thickness and integrity of the prior CS scar in the LUS via ultrasound is a widely supported method for calculating the possibility of uterine rupture or dehiscence, which may occur either spontaneously or throughout a trial of labor; this evaluation can be conducted independently or in combination with clinical factors [(5)].

Numerous research has examined the ultrasonographic evaluation of LUS thickness via transabdominal (TA) methods to predict uterine rupture. A significant correlation has been identified between LUS thickness and the probability of uterine anomalies [(6, 7)]. Nonetheless, the sonographic techniques vary among investigations due to confounding factors, leading to differences in the recommended cutoff values [(8)].

This meta-analysis aimed to provide a comprehensive assessment of the use of trans-abdominal ultrasound in assessing LUS thickness in females with previous cesarean sections, highlighting its predictive value and potential role in clinical decision-making.

PATIENTS AND METHODS

Search strategy: We conducted a thorough search on Google Scholar, PubMed, Embase, & Cochrane Library. The investigation utilized both textual terms and medical subject titles, such as TAS, CS, LUS and TOL across Medline, Embase, ClinicalTrials.gov and Cochrane Library. In addition, we conducted a thorough search on ClinicalTrials.gov and examined the references cited in selected publications and reviews to discover more relevant observational research.

Inclusion criteria: Studies on females with a history of 1 or more cesarean sections, use of trans-abdominal ultrasound (TAUS) for LUS thickness measurement, reporting of delivery outcomes (trial of labor or elective repeat cesarean section following CS) or complications (uterine dehiscence or rupture) and published in English and available as full text.

Exclusion criteria: Studies that used imaging modalities other than trans-abdominal ultrasound (e.g., trans-vaginal ultrasound and MRI), studies that did not report LUS thickness or delivery outcomes and involved women with

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other uterine abnormalities (e.g., fibroids and congenital anomalies), case reports, editorials, reviews, or animal studies and studies that were not published in English or lacked full-text availability.

Data extraction: Two researchers (KKT, HWH) conducted separate assessments of the titles and abstracts of all the papers generated to determine their relevance. We thoroughly examined each trial that was discovered and decided about whether to include it or not. Researchers also independently extracted the data into a standardized data extraction form. The two reviewers established a consensus on decisions about the inclusion of research and data extraction. The 3rd researcher (JJS) would have the final authority to determine trial eligibility and extract data where discrepancies have been discovered.

Ethical considerations: All the procedures of the research were approved by Pediatrics Department and the Investigation Ethics Committee of Damanhour National Medical Institute. Administrative consents required were taken. This study was performed in compliance with the Declaration of Helsinki, the code of ethics of the World Medical Association.

Statistical analysis

Pooled relative risks (RR) and ninety five percent confidence interval have been estimated for the outcomes by a random-effects model. Heterogeneity has been evaluated with the Chi-squared test (Chi-p) and I^2 statistic. Significant heterogeneity has been defined as an $I^2 > 50\%$ and $p < 0.05$. The outcomes are presented in forest plots (Figures 3–5).

RESULTS

Our literature search found 212 studies. Subsequently, after eliminating duplicate entries, 102 studies remained eligible for initial screening. Further evaluation of titles and abstracts led to identifying 21 articles deemed suitable for comprehensive full-text screening. Ultimately 7 articles have been involved in our meta-analysis. The investigation selection process is exhibited in the PRISMA flow diagram in figure (1). This meta-analysis involved seven research from six distinct countries that examined the utilization of transabdominal ultrasound for evaluating thickness of lower uterine segment in cases with a history of CS. The baseline characteristics and summary of the involved investigations are fully presented in table (1).

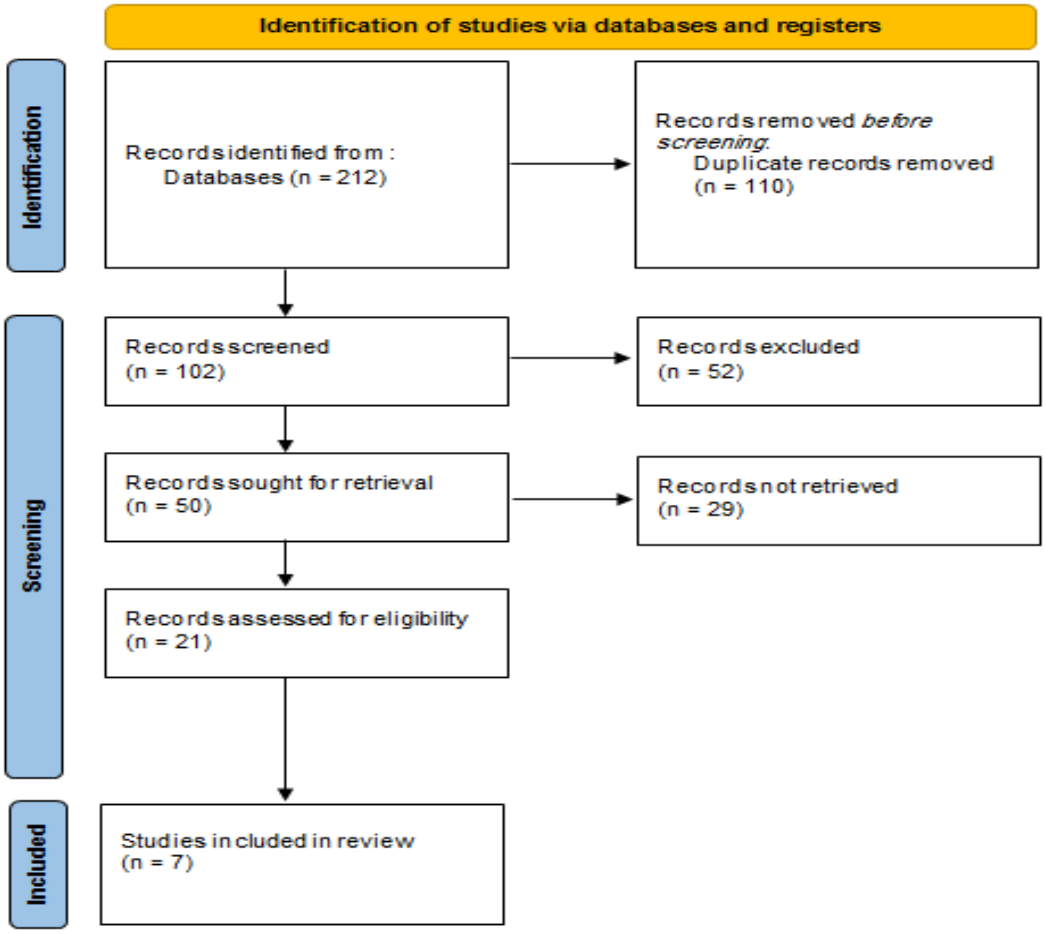

Figure (1): PRISMA flow diagram.

Table (1): Demographic data and summary of our involved investigations

Study ID	Country	Sample size	Measurement	Outcome
Cheung. [9]	Canada	53	trans-abdominal	trial of labor after cesarean
Uharcek. [10]	Slovakia	336	trans-abdominal	ER C/S
Tazion. [11]	Pakistan	70	trans-abdominal	ER C/S
Gizzo. [12]	Italy	45	trans-abdominal	ER C/S
Kushtagi. [13]	India	64	trans-abdominal	ER C/S
Suzuki. [14]	India	83	trans-abdominal	trial of labor after cesarean
Tanik. [15]	Turkey	50	trans-abdominal	ER C/S

In the ROB1 tool, most of our included studies had a high probability of bias in blinding either the patient or the outcome assessment. Most studies had a low risk of bias in randomization and reporting domains (Figure 2 and table 2).

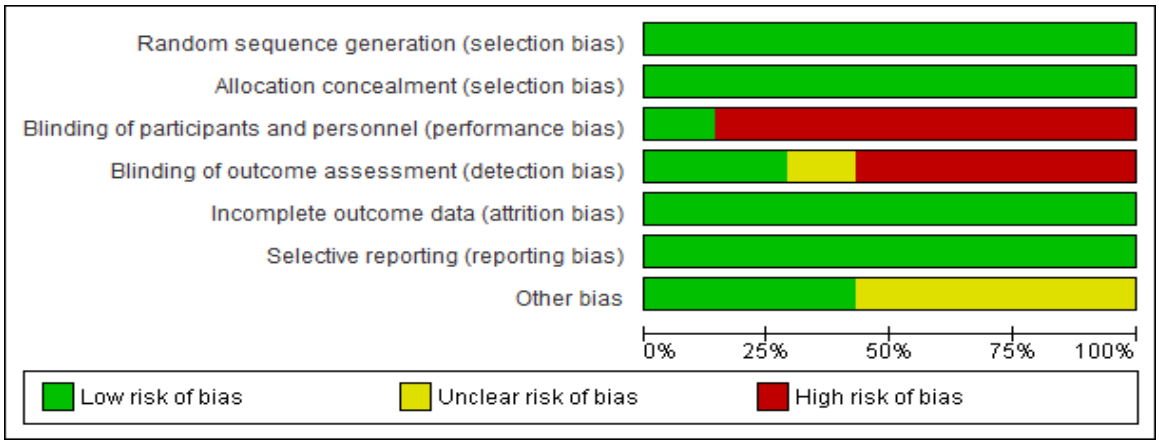

Figure (2): The risk of bias graph.

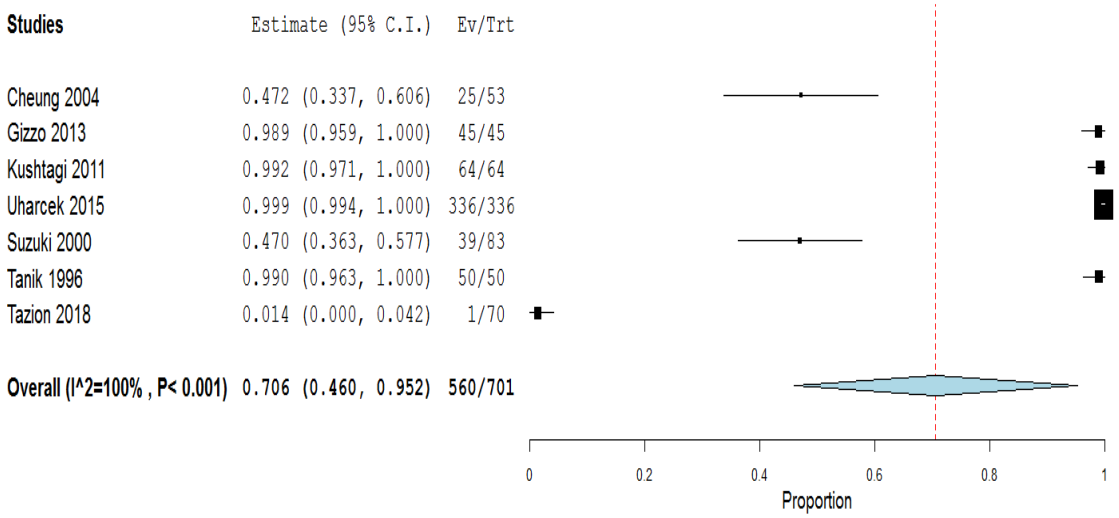

Table (2): the summary of the risk of bias assessment.

The sonographic measurement has been associated with either the delivery outcome or the thickness of the lower uterine portion throughout the repeated Cesarean surgery. The threshold for thickness of LUS varied between 1.5 and 4.05 millimeters in all investigations. Our pooled analysis for this outcome resulted in RR 95%CI= 0.7(0.4, 0.9). The pooled studies show major heterogeneity with chi-p <0.001 and I2 =100%. (Figures 3-5).

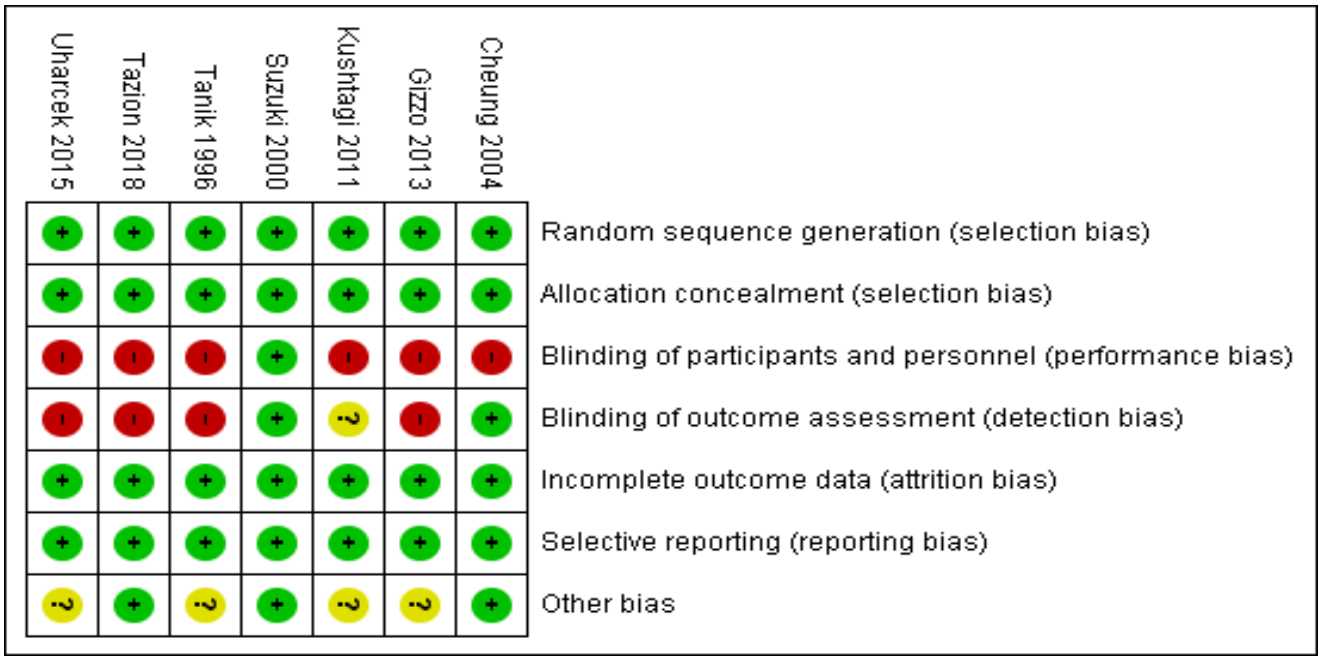

Figure (3): Forest plot for Elective repeat CS.

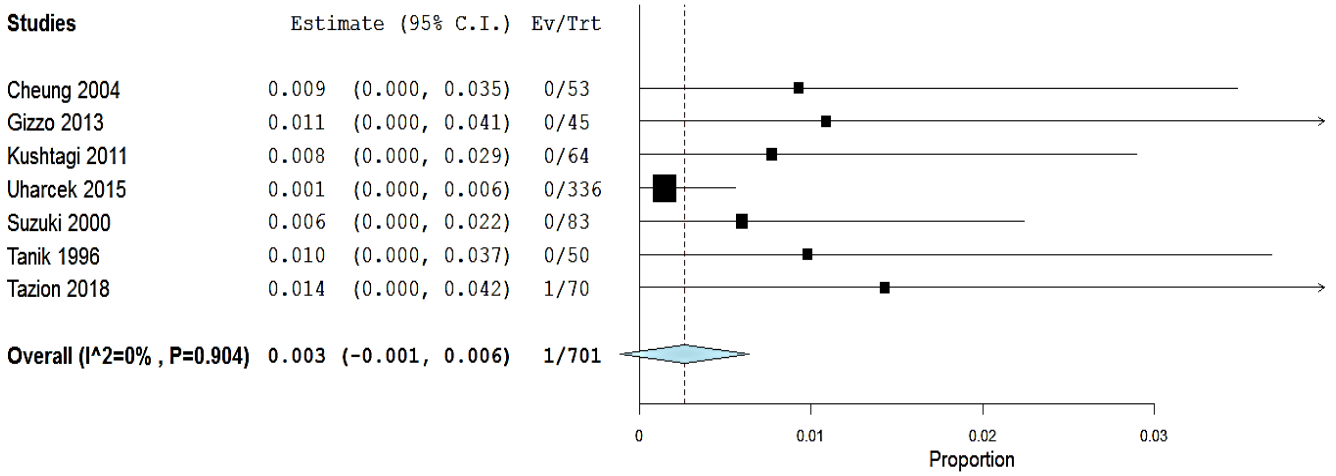

Figure (4): Forest plot for uterine dehiscence.

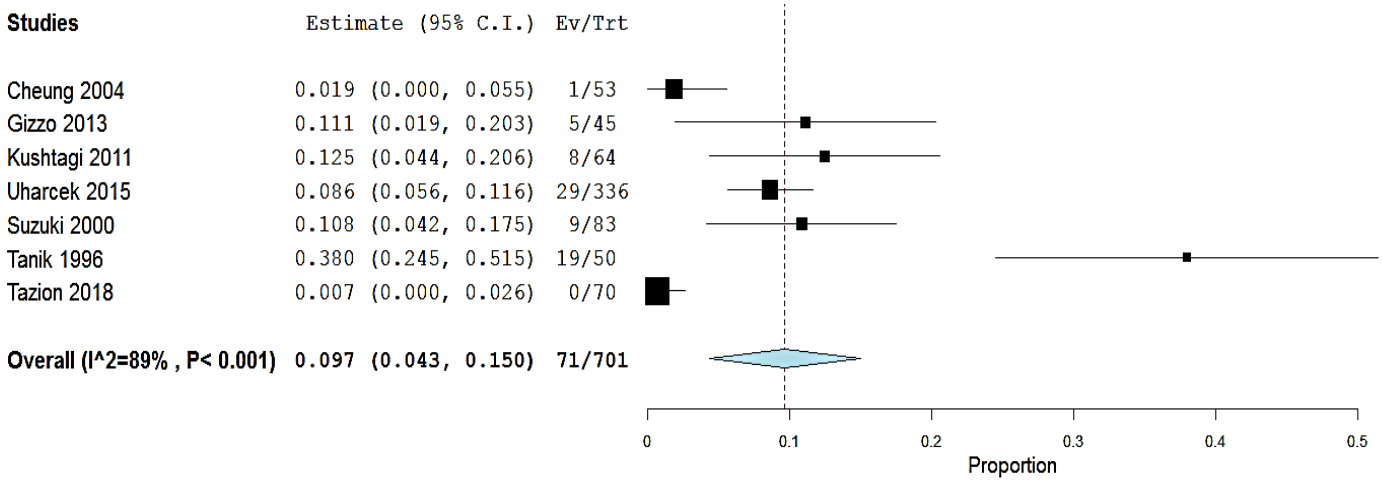

Figure (5): Forest plot for uterine rupture.

DISCUSSION

The increasing rates of cesarean sections (CS) worldwide have led to a growing interest in assessing the uterine scar integrity in subsequent pregnancies [17].

Assessing the thickness of LUS in cases with a history of CS is crucial for predicting the risk of rupture of uterus during labor & guiding decisions on trial of labor after cesarean (TOLAC) [18].

Among the various methods available, trans-abdominal ultrasound (TAUS) has emerged as a non-invasive, accessible tool for measuring LUS thickness. However, its accuracy and reliability compared to other imaging methods remains a subject of debate. Therefore, this meta-analysis aimed to evaluate the utilization of trans-abdominal ultrasound in assessing thickness of LUS in females with previous CS, highlighting its predictive value and potential role in clinical decision-making.

This meta-analysis exhibited that sonographic measurements have been associated with delivery outcomes or reduced thickness of uterine segment after recurrent Cesarean sections. The minimum value for thickness of LUS varied between 1.5 and 4.05 millimeters in all investigations. Moreover, considering the correlation between thin LUS measurements and uterine dehiscence as well as uterine rupture, our pooled research exhibited significant heterogeneity concerning uterine dehiscence. Nonetheless, the pooled research regarding uterine rupture exhibited homogeneity. The results align with those of **Mira *et al.*** [19] who established a clinically applicable cut-off value to facilitate safe vaginal birth utilizing ultrasound on abdomen to assess the LUS thickness in cases with a history of prior CS. Ultrasonographic evaluation facilitates an effective estimate of the risk of scar problems during labor. The thickness of the LUS correlates with the scar grade. The optimal moment for conducting the scan is around the late 3rd trimester. A cut-off value of 2.5 millimeters determined by trans-abdominal can be utilized with a great specificity and sensitivity degree.

Furthermore, **Sen *et al.*** [20] conducted a similar evaluation using ultrasonography to assess the thickness of LUS in females with prior CS, identifying a level of thickness that predicts the safety of vaginal delivery. A 96% association was identified among transabdominal ultrasonography with magnification & TVU. The essential threshold for safe thickness of lower segment, determined from the ROC curve, was 2.5 millimeters. Their investigation indicated that ultrasonographic evaluation facilitates improved estimation of the probability of scar complications during labor, potentially enabling safer delivery management.

Moreover, these findings align with **Uharček *et al.*** [9] who validated the abdominal sonographic assessment thickness of LUS in full-term pregnancies following a single prior CS and evaluated the efficacy of lower uterine segment thickness measurement in predicting the probability of uterine dehiscence. It was found that 2.5 millimeters is regarded as the crucial threshold for lower uterine segment thickness. The pivotal cut-off value has been obtained from the ROC curve, exhibiting specificity, sensitivity, positive predictive value, and negative predictive value of 84%, 90.9%, 71.4%, and 95.5% respectively, utilizing transabdominal ultrasonography. The examination of the linear regression model indicated that a total thickness of LUS less than 2.5 millimeters was the only indicator connected with a translucent lower uterine segment (C3) (8.8% versus. 0%; P = 0.02). They established that a complete LUS thickness of fewer than 2.5 millimeters correlates with an increased risk of dehiscence of uterus.

Furthermore, the current meta-analysis is corroborated by a prior meta-analysis undertaken by **Swift *et al.*** [8] which thoroughly evaluated the prognostic attributes of sonographic measurements of thickness of the LUS for uterine rupture throughout delivery.

The sonographic measurement od was found to correspond with either the delivery outcome or the thickness of the lower uterine segment during repeated Cesarean surgery. The threshold for LUS thickness varied between 1.5 and 4.05 millimeters in all investigations. Additionally, there were eighteen cases (one percent) of uterine rupture, 120 cases (6.6%) of uterine dehiscence, and 1674 cases (92.4%) of women without uterine defects. The summary of Receiver Operating Characteristic Curve demonstrated a sensitivity of 0.88 and a specificity of 0.77. The negative likelihood ratio was 0.11, and the diagnostic odds ratio was 34.0. Ultimately, they determined that a lower uterine segment thickness exceeding 3.65 millimeters, assessed via a standardized ultrasonography method, correlates with a diminished probability of uterine rupture.

CONCLUSION

This meta-analysis demonstrated that trans-abdominal ultrasound (TAUS) is a valuable, non-invasive tool for assessing thickness of LUS in females with previous CS. The findings indicate that sonographic measurements are strongly correlated with delivery outcomes and LUS thickness at the time of frequent CS. These results suggest that TAUS can provide valuable insight into the risk of scar-related complications, like uterine dehiscence and rupture, and informing clinical decisions to ensure safer delivery management.

DECLARATIONS

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- **Conflicts of interest:** No conflicts of interest.
- **Competing interests:** None

REFERENCES

1. **Betran A, Ye J, Moller A *et al*. (2021):** Trends and projections of caesarean section rates: global and regional estimates. BMJ global health, 6 (6): e005671. doi.org/10.1136/bmjgh-2021-005671
2. **Fobelets M, Beeckman K, Faron G *et al*. (2018):** Vaginal birth after caesarean versus elective repeat caesarean delivery after one previous caesarean section: a cost-effectiveness analysis in four European countries. BMC pregnancy and childbirth, 18 (1): 92. doi.org/10.1186/s12884-018-1720-6.
3. **Baradaran K (2021):** Risk of Uterine Rupture with Vaginal Birth after Cesarean in Twin Gestations. Obstetrics and gynecology international, 2021: 6693142. doi.org/10.1155/2021/6693142
4. **Tekin A, Taymur B, Yavuz E *et al*. (2022):** Transabdominal and transvaginal ultrasonographic assessment of lower uterine segment thickness in pregnant women before repeat cesarean section. Haydarpasa Numune Train Res Hosp Med J., 62(3): 320-6.
5. **Betran A , Torloni M , Zhang J *et al*. (2015):** What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. Reprod health, 12: 57. doi.org/10.1186/s12978-015-0043-6.
6. **Jastrow N, Demers S, Chaillet N *et al*. (2016):** Lower uterine segment thickness to prevent uterine rupture and adverse perinatal outcomes: a multicenter prospective study. American journal of obstetrics and gynecology, 215(5): 604.e1–604.e6. doi.org/10.1016/j.ajog.2016.06.018.
7. **Kok N, Wiersma I, Opmeer B *et al.* (2013):** Sonographic measurement of lower uterine segment thickness to predict uterine rupture during a trial of labor in women with previous Cesarean section: a meta-analysis. Ultrasound Obstet Gynecol., 42(2): 132–139. doi.org/10.1002/uog.12479.
8. **Swift B, Shah P, Farine D (2019)**: Sonographic lower uterine segment thickness after prior cesarean section to predict uterine rupture: A systematic review and meta-analysis. Acta obstetricia et gynecologica Scandinavica, 98(7):830–841. doi.org/10.1111/aogs.13585
9. **Uharček P, Brešťanský A, Ravinger J *et al.* (2015)**: Sonographic assessment of lower uterine segment thickness at term in women with previous cesarean delivery. Archives of gynecology and obstetrics, 292(3):609–612. doi.org/10.1007/s00404-015-3687-0
10. **Cheung V, Constantinescu O, Ahluwalia B (2004)**: Sonographic evaluation of the lower uterine segment in patients with previous cesarean delivery. Journal of ultrasound in medicine : official journal of the American Institute of Ultrasound in Medicine, 23(11): 1441–1447. doi.org/10.7863/jum.2004.23.11.1441
11. **Gizzo S, Zambon A, Saccardi C *et al*. (2013)**: Effective anatomical and functional status of the lower uterine segment at term: estimating the risk of uterine dehiscence by ultrasound. Fertility and sterility, 99(2):496–501. doi.org/10.1016/j.fertnstert.2012.10.019
12. **Kushtagi P, Garepalli S (2011)**: Sonographic assessment of lower uterine segment at term in women with previous cesarean delivery. Archives of gynecology and obstetrics, 283(3): 455–459.doi.org/10.1007/s00404-010-1384-6.
13. **Uharček P, Brešťanský A, Ravinger J *et al*. (2015):** Sonographic assessment of lower uterine segment thickness at term in women with previous cesarean delivery. Archives of gynecology and obstetrics, 292(3):609–612. doi.org/10.1007/s00404-015-3687-0
14. **Suzuki S, Sawa R, Yoneyama Y *et al*. (2000):** Preoperative diagnosis of dehiscence of the lower uterine segment in patients with a single previous Caesarean section. The Australian & New Zealand journal of obstetrics & gynaecology, 40(4): 402–404.doi.org/10.1111/j.1479-828x.2000.tb01168.x
15. **Tanik A, Ustun C, Cil E, Arslan A (1996)**: Sonographic evaluation of the wall thickness of the lower uterine segment in patients with previous cesarean section. Journal of clinical ultrasound: JCU, 24(7):355–357. doi.org/10.1002/(SICI)1097-0096(199609)
16. **Tazion S, Hafeez M, Manzoor R, Rana T (2018):** Ultrasound Predictability of Lower Uterine Segment Cesarean Section Scar Thickness. Journal of the College of Physicians and Surgeons--Pakistan: JCPSP., 28(5):361–364. doi.org/10.29271/jcpsp.2018.05.361
17. **Huang J, Phillips C, Moshiri M (2023)**: Scarred for life: a review of cesarean section scar pregnancy and potential pitfalls in diagnosis. Abdominal radiology (New York), 48(8): 2672–2683. doi.org/10.1007/s00261-023-03953-7.
18. **Uharček P, Brešťanský A, Ravinger J (2015)**: Sonographic assessment of lower uterine segment thickness at term in women with previous cesarean delivery. Arch Gynecol Obstet., 292(3):609-12.
19. **Mira I, Sedek A, Ahmed A (2019).** The Use of Trans Abdominal Ultrasound in Assessment of the Lower Uterine Segment Thickness in Patients with Previous Cesarean Section. The Egyptian Journal of Hospital Medicine, 74(6):1306-1313. doi: 10.21608/ejhm.2019.26688
20. **Sen S, Malik S, Salhan S (2004)**: Ultrasonographic evaluation of lower uterine segment thickness in patients of previous cesarean section. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics, 87(3): 215–219. doi.10.1016/j.ijgo.2004.07.023.