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Review Article

Scoping review of the evaluation of lower uterine segment thickness and trial of labour after caesarean section

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ABSTRACT

The fact that the integrity of the lower uterine segment (LUS) has not been routinely evaluated sonographically before deciding on the mode of delivery after caesarean section has deemed it fit that the lower uterine segment thickness (LUST) should be assessed. The authors carried out a scoping review in October 2023. Four databases were searched for peer reviewed articles that discussed evaluation of LUST and TOLAC. The year of publication, primary author's country of origin, sample size, study design, gestational age at ultrasonographic assessment, scanning route and key findings were extracted from the included articles. The articles identified were 625 while 250 were screened after removing duplicates and finally 30 articles were included in the review. The first authors of the included articles originated from 10 different countries and 30% of them were Indians. The most frequently used study designs in the articles were prospective cohort studies (63.3%). Majority of the key findings were as follow: Ultrasonography is the best modality for LUS assessment, LUST measurement is more reliable through vaginal scan; maternal age, body mass index and pregnancy related factors affect LUST and LUST of ≥3.5 mm at term is safe for TOLAC. Maternal socio-demographic characteristics and past obstetric history affect the LUST and success of TOLAC. Ultrasonographic evaluation of the LUST at term is safe, needed before TOLAC and more reliable when conducted through vaginal route. The LUST influences the pregnancy outcome during TOLAC and a LUST cut-off value of ≥3.5 mm is safe for TOLAC.

Keywords: Evaluation, Lower uterine segment thickness, Trial of labour after caesarean section, Review

INTRODUCTION

Rationale

The term lower uterine segment was introduced into medical practice by Bandle while Aschoff described the upper border of the lower uterine segment and the corpus as the ostium internum anatomicum and below the cervix as the ostium internum histologicum.[1] In 1916, a dictum of "once a caesarean, always a caesarean" was made by Cragin.[2] As the lower uterine segment transverse incision emerged, the American College of Obstetricians and Gynaecologists (ACOG) and the National Institute of Health (NIH) advocated trial of labour after caesarean

section (TOLAC) resulting in higher rate of vaginal birth after caesarean (VBAC) in the United States of America.[3]

Globally, the caesarean section rate increment especially in women with a previous lower uterine segment caesarean delivery who could have benefitted from TOLAC has been alarming. The World Health Organization (WHO) recommended caesarean section rate between 10-15%.[3] Studies have shown caesarean section rate of between 25% to 30% in the United States and 67% in the United Kingdom.[4-6] Caesarean section rate in Tanzania was 31.8% while studies in Nigeria reported between 15-25%.[7-10] Irrespective of the belief in our environment that delivery through the abdominal route amounts to reproductive failure, its cost implication and associated complications there is still a surge in caesarean section rate in Nigeria.

The fear of uterine rupture and its attending complications such as obstetric haemorrhage, fetomaternal morbidity and mortality due to unsuccessful trial of labour after caesarean section is the major culprit behind repeat abdominal delivery.[11] Uterine rupture following unsuccessful TOLAC has been overrated. Several studies reported that the rate of uterine rupture during trial of labour after a previous lower segment caesarean delivery is between 0.1% to 2.5%.[12-14] Various studies gave 56% to 80% success rate of TOLAC.[15-17] On the same vein several researches have shown success rates of TOLAC of 72-76%.[17-19] Despite low uterine rupture rate and high success rate of TOLAC there is no strong conviction to rely solely on the assessment of clinical variables before embarking on TOLAC thus, resulting in drastic decline in the practice of TOLAC.

Researches have reported that the probability of uterine rupture in the presence of a defective scar is directly related to the degree of thinning of the lower uterine segment.[20-22] The aversion for caesarean section and its cost implication compared to vaginal birth in low-income countries like ours and also the fact that the integrity of the lower uterine segment has not been routinely evaluated sonographically before deciding on the mode of delivery after caesarean section have deemed it fit that the lower uterine segment thickness should be assessed. This will help to establish the critical lower uterine segment thickness value at which trial of labour is safe which will increase the rate of TOLAC and in turn reduce the high caesarean section rate and its attending complications.

There has been diversity of opinion concerning the lower uterine segment thickness of women being planned for trial of labour after caesarean section, the effect of socio-demographic factors on the lower uterine segment thickness and success of trial of labour after caesarean section, the influence of past obstetric history on the lower uterine segment thickness and success of trial of labour after caesarean section, the influence of lower uterine segment thickness on pregnancy outcome and the critical lower uterine segment thickness at which trial of labour after caesarean section is safe. The evidence to strongly conduct routine ultrasonography of lower uterine segment thickness before TOLAC is also limited. For these reasons, a scoping review was conducted in order to systematically map the research done in this area, as well as to identify any existing gaps in knowledge.

Objectives

To systematically map the research done on the influence of lower uterine segment thickness and its determinants on the success of trial of labour after caesarean section and as well as to identify any existing gaps in knowledge. The research questions are: What is the lower uterine segment thickness of a woman being planned for trial of labour after caesarean section? What are the effect of socio-demographic factors on the lower uterine segment thickness and success of trial of labour after caesarean section? Can past obstetric history affect the lower uterine segment thickness and success of trial of labour after caesarean section? Can the thickness of the lower uterine segment affect pregnancy outcome? What is the cut-off lower uterine segment thickness at which trial of labour after caesarean section is safe?

METHODS

Eligibility criteria

To be included in this review, papers needed to be in alignment with the conceptual framework of the study and also focus on the evaluation of lower uterine segment thickness, its determinants and trial of labour after caesarean section. Peer-reviewed journal papers were included if they were published between the period of 2013 to 2023, written in English and described ultrasonographic assessment of the lower uterine segment thickness, determinants of lower uterine segment thickness, influence of lower uterine segment thickness and its determinants on success of trial of labour after caesarean section. Papers with different conceptual framework, written prior to the specified period or in any language other than English and as well deviated from the subject matter were excluded as they would not be representative of the objectives of the review.

Information sources

To identify potentially relevant documents, a medical librarian with expertise in systematic searching drafted a strategy using the terms ‘‘evaluation of lower uterine segment thickness, determinants of lower uterine segment thickness, success of trial of labour after caesarean section’’ and relevant subject headings when available. For the larger interdisciplinary database Scopus, an additional search string pertaining to health was included to refine the results. The librarian searched MEDLINE via PubMed, Embase via Elsevier, APA PsycINFO via EBSCO, and Scopus via Elsevier from inception to 31 October 2023. All results were compiled in EndNote and imported into Covidence. For a supplementary search

strategy, researchers identified additional articles via an initial Google Scholar search in September 2023.

Selection of sources of evidence

Abstracts and articles that addressed the evaluation of lower uterine segment thickness, determinants of lower uterine segment thickness, success of trial of labour after caesarean section were included in the screening. Excluded articles were those having conceptual framework different from the subject of interest, written prior to the specified period or in any language other than English or those that contextualized the subject matter outside of the defined settings. The screening process involved two research team members reading abstracts, and then voting as individuals on whether to include or exclude articles. Conflicts in voting were discussed between the reviewers to reach a consensus. The articles that passed abstract screening were then read in full and once again voted on. Articles that were only an abstract such as a published abstract from an oral presentation at a conference or editorial were included.

Data charting process

From the included studies, a data extraction form was created using Excel Software (Version 16.56, Redmond, WA). The following data were collected: Year of publication, primary author's country of origin, sample size, study design, gestational age at ultrasonographic assessment, scanning route and key findings. Any discrepancies in data interpretation were discussed and resolved.

Data items

We abstracted data on article characteristics such as year of publication, primary author's country of origin, sample size, study design, gestational age at ultrasonographic assessment, scanning route and key findings. Other information obtained were determinants of lower uterine segment thickness such as socio-demographic factors of the study population and their past obstetric histories.

RESULTS

Selection of sources of evidence

The search from electronic databases and review article references in 31 October, 2023 identified 625 citations. After the removal of duplicates, the original search yielded 250 citations and having screened the titles and abstracts, judging from inclusion and exclusion criteria 50 citations remained. From the 50, 5 articles were excluded because their full texts were not available in English, 13 were excluded because they deviated from the context of interest, and two were excluded because, despite having the right setting, the outcome focus were outside of the scope of interest. Thus, 30 articles were included in the review (Figure 1).

Characteristics of sources of evidence

Of the 30 included articles, the first authors originated from 10 different countries: India (9, 30%), Egypt (8, 26.7%), Iraq (5, 16.7%), Turkey (2, 6.7%), Japan (1, 3.3%), Nigeria (1, 3.3%), Thailand (1, 3.3%), United States of America (1, 3.3%), Canada (1, 3.3%) and Saudi Arabia (1, 3.3%). Publication years of the included articles ranged from 2013 to 2023 with 2015 having the highest number of publications (6, 20%). The most implemented study design was prospective (cohort and observational) yielding 19 of the included articles (63.3%). Other study designs used were: cross-sectional (7, 23.3%), retrospective (2, 6.7%), systematic review (1, 3.3%) and descriptive (1, 3.3%).

Table 1: Synthesis of results.

Year	1st author's country	Study design	Sample size	Scanning period (weeks)	Scanning route	Key findings
2022	Egypt	Cross-sectional	130	37-40	Abdominal/ vaginal	Measurement of lower uterine segment (LUS) is more reliable vaginally
2015	Egypt	Prospective observational	75	36	Abdominal/ vaginal	Lower uterine scar dehiscence rate differs based on scanning route
2022	Turkey	Cross-sectional	317	38-40	Abdominal	LUS is a predictor for scar defect in previous caesarean section
2016	Iraq	Prospective cohort	107	36-39	Abdominal	LUS is thinner in those with prior caesarean section than those with prior vaginal delivery
2018	India	Cross-sectional	30	37-39	Abdominal	Ultrasonography is the best modality in LUS assessment
2015	India	Prospective cohort	100	37-40	Abdominal	There is strong correlation between ultrasonographic LUS and intra-operative findings

Continued.

Year	1st author's country	Study design	Sample size	Scanning period (weeks)	Scanning route	Key findings
2015	India	Prospective cohort	50	>37	Abdominal	Ultrasonography of LUS scar thickness is safe and needed before trial of scar after caesarean
2015	India	Prospective cohort	103	37-40	Abdominal	LUS transabdominal sonography is safe and reliable
2015	India	Prospective cohort	240	37-40	Vaginal	LUST of 2.5 mm is safe for trial of labour after caesarean
2021	Thailand	Cross-sectional	111	38-40	Abdominal	Abdominal ultrasound is a valuable tool for preoperative prediction caesarean scar defect
2023	Iraq	Prospective cohort	250	37-39	Abdominal	Maternal age, body mass index and pregnancy related factors affect the LUST
2016	Japan	Retrospective cohort	99	37-41	Vaginal	Sonographic measurement of LUS is reliable in predicting uterine rupture in prior uterine scar
2015	India	Prospective cohort	96	36	Abdominal	Factors at primary caesearean influence the LUS at term in subsequent pregnancy
2018	India	Prospective observational	40	>36	Abdominal	LUST scan assesses the scar integrity and delivery mode after caesarean section
2023	Nigeria	Prospective cohort	338	36	Vaginal	LUST of ≥3.5 mm at 36 weeks gestation is associated with successful trial of scar
2023	Iraq	Prospective cohort	100	38-40	Abdominal/ vaginal	LUST scan helps to decide on mode of delivery after prior caesarean section
2019	America	Prospective cohort	166	11-13 /35-38	Vaginal	1st trimester LUS assessment should not decide mode of delivery
2022	Egypt	Cross-sectional	161	Labour	Abdominal	LUST of 2.3 mm in 1st stage of labour is associated with scar defect in trial of labour
2013	India	Descriptive	200	37-42	Abdominal	LUST of 3.5 mm is safe for trial labour after caesarean section
2013	Egypt	Prospective cohort	150	38-40	Vaginal	The number of layers of caesarean section closure affects the LUST
2023	Egypt	Cross-sectional	200	37-39	Abdominal	LUST ultrasound measurement has a higher degree of accuracy with 3D than 2D ultrasonography
2021	Turkey	Cross-sectional	555	37-40	Abdominal	LUST scanning in a previous scar is useful in risk assessment and and labour management
2020	Egypt	Prospective cohort	110	37-40	Abdominal	LUST evaluation is useful in deciding mode of delivery and checking of risk in trial of labour
2018	India	Prospective cohort	200	37-40	Abdominal	Prenatal scar assessment using ultrasound is useful in evaluation of previous caesarean scar
2013	Iraq	Prospective observational	143	36-40	Abdominal	LUST ultrasonography is a strong predictor for uterine scar defect in a prior caesarean scar
2022	Iraq	Prospective observational	100	36-38	Abdominal/ vaginal	LUS measurement is more accurate with vaginal than abdominal scan
2023	Egypt	Retrospective observational	60	36-40	Vaginal	Vaginal LUS ultrasound has higher sensitivity and -ve predictive value
2019	Canada	Systematic review	28	36-38	Abdominal/ vaginal	LUST of >3.65 mm is associated with a lower risk of uterine rupture

Continued.

Year	1st author's country	Study design	Sample size	Scanning period (weeks)	Scanning route	Key findings
2021	Saudi Arabia	Prospective cohort	120	36-38	Abdominal/ vaginal	LUS is thinner in previous caesarean section scarred uterus than the unscarred uterus
2019	Egypt	Prospective cohort	200	37-40	Abdominal	LUST ultrasound evaluation permits good assessment of the risk of scar defects intrapartum

LUS-Lower uterine segment, LUST-lower uterine segment thickness

The highest sample size in the included articles was 555 pregnant women while the lowest was 28 pregnant women. Nineteen articles had sample size above 100. Majority of the lower uterine segment thickness ultrasonographic assessments were conducted at gestational ages greater than 35 weeks and only one article examined the lower uterine segment thickness sonographically at labour. Seven articles (23.3%) combined transabdominal and vaginal ultrasonographic routes in assessing the lower uterine segment thickness, 18 articles (60%) utilized transabdominal route only while 5 articles (16.7%) carried out theirs with the use of vaginal route alone. The key findings in the included articles provided answers to the research questions of this scoping review.

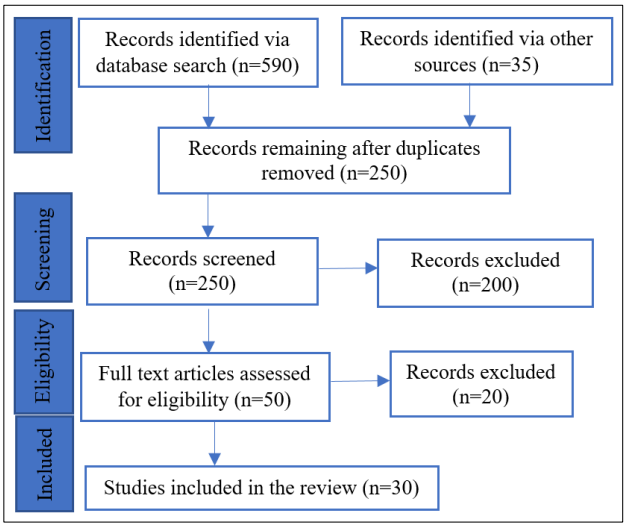

Figure 1: PRISMA flowchart summarizing scoping review process.

PRISMA: Preferred reporting items for systematic reviews and meta-analyses

DISCUSSION

In this scoping review 30 primary studies addressing evaluation of lower uterine segment thickness and trial of labour after caesarean section were identified. The findings showed that the past obstetric history and socio-demographic characteristics affect the lower uterine segment thickness and success of trial of labour after caesarean section; sonographic evaluation of the lower uterine segment thickness in the third trimester assesses the integrity of uterine segment after caesarean section, it is useful in risk assessment, it helps in deciding mode of delivery and more reliable when conducted via vaginal route as opposed to transabdominal route. In addition to the above observations, this scoping review also found out that ultrasonographic measurement of the lower uterine segment thickness is safe and needed before trial of scar after caesarean section; the lower uterine segment is thinner in those with previous caesarean section than those with previous vaginal delivery; the lower uterine segment thickness influences the pregnancy outcome during trial of labour after caesarean section and there is critical lower uterine segment thickness value that is safe for trial of labour after caesarean section. The above findings were in turn with the research questions and the objectives of this scoping review.

Several methods have been suggested as means of visualizing the lower uterine segment and measuring the thickness, these modalities include; hysterography, sonohysterography, hysteroscopy, magnetic resonance imaging and ultrasonography.[23,24] Similar study has reported the use of hysterography, pelvic examination, amniography and X-ray pelvimetry to evaluate the lower uterine segment after caesarean delivery however, they have not proved useful for estimation of the safety of trial of labour after caesarean section.[21]

Ultrasonography involves the use of high frequency sound waves and it can be used to identify the layers of the lower uterine segment.[25] It has also been shown to be the best modality for assessing the lower uterine segment because it is non-invasive, does not use ionizing radiation and is readily available.[26] The lower uterine segment thickness can be measured sonographically through the abdominal or vaginal route.[4] Transabdominal sonography is safe and reliable test with a high degree of specificity and sensitivity.[12] However, sonographic measurement of the lower uterine segment thickness is more reliable and accurate through the vaginal route.[25,27,28] Ultrasonographic evaluation of scar thickness is a safe and accurate procedure and is recommended in considering a trial of labour after one previous caesarean section.[4] A prior caesarean delivery is associated with a sonographically thinner lower uterine segment when compared with those with prior vaginal delivery.[21,29]

The lower uterine segment thickness can be influenced by several factors which in turn affect the success of trial of

labour after caesarean section and the pregnancy outcome. Labour at the time of previous caesarean section and the use of synthetic sutures as opposed to catgut sutures for the closure of previous lower uterine surgical wound are associated with a thicker lower uterine segment near term in the subsequent pregnancy.[30] It has been shown that maternal age, body mass index and pregnancy related factors affect the lower uterine segment thickness.[31] A study concluded that non-recurrent indications of prior caesarean sections are associated with thinner lower uterine segment near term.[32] A similar reviewed article observed that significant abnormal lower uterine segment thickness were detected in those with preterm primary caesarean section, single layer uterine closure, inter-caesarean interval of 54 months, maternal age beyond 35 years, caesarean section performed in labor, following 18 hours of rupture of membrane, those whose babies weight were more than 3 kg, whose primary caesarean delivery were closed with polyglactin or chromic catgut and also who had post-partum fever.[33]

The vaginal delivery of a woman with previous caesarean delivery without any adverse pregnancy outcome is called successful trial of labour after caesarean section.[11] The lower uterine segment thickness plays a significant role on the success of vaginal birth after caesarean section. Studies have shown that the likelihood of uterine rupture in the presence of a defective scar is directly related to the degree of thinning of the lower uterine segment.[12-14] Various researches have shown success rates of a planned trial of labour after a caesarean section of 72-76%.[17-19] The lower uterine segment thickness ultrasonographic assessment in a previous caesarean scar is helpful in risk assessment and labour management.[34] Another reviewed article concluded that ultrasonographic examination is useful in decision making concerning mode of delivery and risk assessment in women with a previous caesarean section embarking on trial of labour.[35] One among the articles reported that as the scar thickness on the lower uterine segment increases the less the chance of uterine dehiscence and rupture during trial of labour after caesarean.[11] It has also been found out that full lower uterine segment thickness of ≥3.5 mm at 36 weeks of gestation is associated with an increased chance of successful trial of labour after caesarean section while lower uterine segment thickness of <3.5 mm is at increased risk of uterine rupture or uterine dehiscence during trial of labour after caesarean section.[36]

There has not been any ideal cut-off value of the lower uterine segment thickness below which trial of labour after caesarean section should not be allowed.[27] A study has derived lower uterine segment thickness cut-off value of 2.5 mm as being safe for trial of labour after a previous caesarean section.[37] Majority of the studies have recorded lower uterine segment thickness cut-off value of ≥3.5 mm as safe uterine thickness after caesarean section for a successful trial of labour after abdominal delivery.[13,36,38] One of the articles concluded that lower uterine segment thickness of 2.3 mm and myometrial thickness of 1.9 mm during the first stage of labor are associated with a high risk of uterine defects during trial of labour after caesarean section.[39] This study recruited the participants when they were in active phase of labour which could affect the thickness of the lower uterine segment since the cervix has started dilating.

Limitations

Published articles on the subject matter that were written in any language other than English were not included in the review. The review included articles published over a period of ten years (2013-2023) in order not to analysed out-dated information. A longer period of years would have been more representative.

CONCLUSION

Maternal socio-demographic characteristics and past obstetric history affect the lower uterine segment thickness and success of trial of labour after caesarean section. Ultrasonographic evaluation of the lower uterine segment thickness in the third trimester is safe and needed before trial of labour after caesarean section; it assesses the integrity of lower uterine segment after caesarean section, it is useful in risk assessment, it helps in deciding mode of delivery and more reliable when conducted via vaginal route as opposed to transabdominal route. The lower uterine segment is thinner in those with previous caesarean section than those with previous vaginal delivery. The lower uterine segment thickness influences the pregnancy outcome during trial of labour after caesarean section and a lower uterine segment thickness cut-off value of ≥3.5 mm is safe for trial of labour after a caesarean section.

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