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COMPARISON OF SONOGRAPHIC CHANGES IN EARLY POST-PARTUM PERIOD IN NORMAL VAGINAL AND CESAREAN DELIVERIES: A SYSTEMATIC REVIEW

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ABSTRACT

Post partum period is the duration of 6 weeks following delivery of the child along with placenta. The most important physio-anatomical change that occurs during this period is the uterine involution where uterus reverts back from its huge pregnant state to normal non pregnant state. Various sonographic studies are useful for studying this process with better understanding. As maternal death during this period is one of the major issue of concern, its detail comprehension may play pivotal role to confine obscure ailments. Present study is a retrospective systematic review which includes the clinical studies based on various sonographic diagnostic techniques to study the normal physiological process of uterine involution during early puerperium and comparing the results in normal vaginal and cesarean deliveries. Potentially eligible studies were searched according to the PRISMA guidelines. Outcomes of four selected clinical studies are presented and compared to mitigate the ambiguous findings.

Keywords: Puerperium, Uterine involution, Ultrasound, Vaginal delivery, Cesarean delivery

INTRODUCTION

Post partum period or puerperium period is the duration of 6 weeks following delivery when the uterus which weighs more than one kg soon after delivery, undergoes physiological process of involution and returns to its non-pregnant state **[1]**. Immediately after delivery, the fundus of uterus lies about 4 cm below umbilicus or more accurately 12 cm above the pubic symphysis of the puerperal mother. In around 6 weeks it returns to its non palpable pre pregnancy stage by the process of autolysis where muscle cells diminish in size due to enzymatic digestion of cytoplasm. This process do not create any difference in the number of muscle cells as the protein that is created from the autolysis is absorbed into the blood stream and excreted through urine **[2]**. Uterine involution was previously assessed by palpating the fundal height but it was difficult to assess in obese and women with uterine myoma **[1]**. After the initiation of ultrasound by Ian Donald et al. in 1958, it became easier to properly assess the uterine measurements and the changes occurring in it **[3]**. Ultrasonography is the front line diagnostic technique in woman with suspected postpartum complications either after vaginal delivery or after cesarean section **[4-7]**. Description of normal ultrasound changes of uterus in puerperium is important for diagnosing the pathological conditions apart from normal conditions. This prevents the unnecessary invasive procedures and improves the maternal health **[8]**. Many studies have been done to explore the normal sonographic changes in uterus during the puerperium. Most of them are done on animals while those which are performed in humans have either taken normal delivery or cesarean delivery in their study and didn't compare the findings in both kinds. Ultrasound may have a pivotal role in a subset of post partum haemorrhage complications in women and to help decide the therapeutic strategy in case of excessive bleeding. This is even more important during early puerperium when the chances of female mortality due to post partum haemorrhage are more **[9]**. The early puerperium is the initial first week following delivery and removal of placenta **[8]**.

Gray scale, color doppler, pulsed Doppler and 3D USG are used in different studies for perfect monitoring of changes during puerperium. Among them color doppler and pulsed Doppler assess haemodynamic events occurring during puerperium while 3D USG is the best way to monitor uterine volume **[10]**. Not many clinical studies have been

conducted so far to evaluate the normal sonographic changes during early puerperium comparing vaginal and cesarean deliveries. To properly monitor this natural phenomenon, the length, width, antero-posterior (A-P) diameter, uterine volume and endometrial thickness are noted down and compared [11, 12]. During early and middle puerperium i.e. around 2 weeks of delivery the uterus is abdominal so mostly abdominal ultrasound is done while in late puerperium uterus shifts in the true pelvis so transvaginal ultrasonography (TVS) is preferred for detecting minute details [10]. Post partum uterus should be examined in sagittal, coronal and transverse sections. However, Wachsberg et al. has recommended for segmental measurement of uterus during early puerperium as the uterus is retroflexed and angulated and it arches over sacral promontory [13]. This study includes the comparative assessment of post partum uterine dimensions with different sonographic techniques which can emphasize on the better and accurate understanding about changes in uterus. This would be more appropriate step towards enhancement in accuracy in the field of diagnosis based further clinical interventions and avoiding peddling measures. This study is a retrospective systematic review to compare

the normal sonographic changes occurring during early puerperium in vaginal and cesarean deliveries.

MATERIALS AND METHODS

Data Source

Google scholar, DHARA, AYUSH research portal, MEDLINE (Pub med) and Cochrane Register of Controlled Trials were searched for the relevant articles for the systematic review. Electronic search consisted of following search strings to find the clinical studies:

'Uterine involution AND ultrasound*', 'Uterus AND Postpartum', 'Uterus, postpartum AND Ultrasound' and 'Uterine involution, postpartum AND ultrasound'

Selection Criteria

Search was restricted to open access journal excluding patents and citations. Studies published within 10 years were selected for review. Last search was done on 5th June 2020. Only clinical studies fulfilling the eligibility criteria were reviewed thoroughly.

Inclusion Criteria

a) Must include a clinical study in human
b) Must be published in English
c) Must be accessible in full text
d) Studies should be open access

e) Studies involving sample of both normal vaginal and cesarean deliveries

Exclusion Criteria

a) Studies involving other than ultrasound technique

b) Studies involving case reports and review articles

c) Studies done on animals

d) Studies involving sample of abnormal or complicated deliveries.

Data Extraction and Synthesis

Data was extracted systematically from all articles selected and reviewed in full text including authors, year in which study was published, place where study was conducted, characteristics of sample (sample size, age range, period of gestation, parity and mode of delivery) and their methodology and finally compare their outcomes. Studies were selected according to PRISMA guidelines and is been shown in **Figure 1**. The first two authors searched the databases and selected the relevant studies independently. Potentially eligible articles were read in full by both reviewing authors and any discrepancies were discussed with the third and fourth review authors until consensus was reached.

RESULTS

Literature search

6803 articles online were found after applying the keywords and eligibility criteria restrictions and one offline thesis held in Department of Rachana Sharir, Faculty of Ayurveda, I.M.S., B.H.U, Varanasi, India was identified. Duplicated articles were removed. All the articles were screened by going through their abstracts keenly and it was found that only 4 studies matched our eligibility criteria. Details are shown in the PRISMA flowchart in **Figure 1**.

So far, the majority of the studies that described the ultrasonographic details of the pelvis after delivery have focused on complications **[11, 14]** and the studies that report normal findings focus predominantly on the uterine cavity in the late post-partum period **[15, 16, 17]**. Uterine artery resistance index (RI) which is measured by Doppler ultrasonography early after delivery has received little attention and only few studies deal with it **[18, 19] (Table 1)**.

Study Characteristics

As shown in **Table 1**, the average size of study sample was 88.25, with a minimum of 47 to maximum of 123 subjects and age range also varied with minimum of 13 to maximum of 42 years. Inclusion criteria in most of the studies included those women who had undergone uneventful vaginal delivery or uncomplicated cesarean section.

Subjects having any pregnancy associated complications were excluded from the studies. General description of data of parity, (**Table 2**) gestational age at delivery, mode of delivery and birth weight were collected from the selected studies.

Methodology adopted in selected studies

All the selected studies have taken ultrasound as their main diagnostic tool but duration of ultrasonography is different in different studies **(Table 3)**.

Percutaneous ultrasonography for measurement of the uterus was done by Lousquy *et al*. **[9]** All the subjects were examined at 2 hours and 24 hours of uneventful delivery. The blood flow of the uterine arteries was done via color and pulsed Doppler evaluation of the uterine arteries in the longitudinal plane. Data was analyzed and comparison of categorical variables was done with the Fisher exact test while the quantitative variables were compared with the help of Wilcoxon rank sum test for paired data or the Student t-test. In other study by Cilingir *et al*. **[20]** trans-abdominal ultrasound was done of all the selected subjects at 24 hours following delivery. They used Student's t test to compare the normally distributed variables and Mann–Whitney U test to compare variables, which were not normally distributed. Fisher's exact and

Yates' continuity correction tests were also used to compare the data and Pearson's correlation test was used to find the correlation between the variables. Brenner *et al*. **[21]** examined the uterine cavity within 48 hours of delivery using both 2D and 3D ultrasonography. 3D volumes of the uterine cavity were acquired in the midsagittal plane of uterus. They also used Doppler imaging to evaluate the flow in the uterine cavity in all patients. Data collected was analyzed and statistical approach was done with independent 1-tailed t tests. Kristoschek *et al*. **[22]** performed pelvic (trans-vaginal and trans-abdominal) ultrasound evaluations on days 1 (D1), 2 (D2) and 7 (D7) of the postpartum period. In this study, parametric and nonparametric mean comparison tests i.e. analysis of variance [ANOVA] and Spearman's rank correlation coefficients were used. In all the studies P-value < 0.05 was considered to be significant. In all the studies mid-sagittal and/or axial planes of the uterus were used to measure the uterine length and the uterine width. Endometrial thickness is also measured in mid-sagittal plane. Cilinger *et al*. **[20]** also evaluated the distance between the uterine fundus and promontorium and the distance between the uterine fundus and L5 vertebra in the mid-sagittal plane of the uterus. The comparison of all these evaluated variables is shown in **Table 4**.
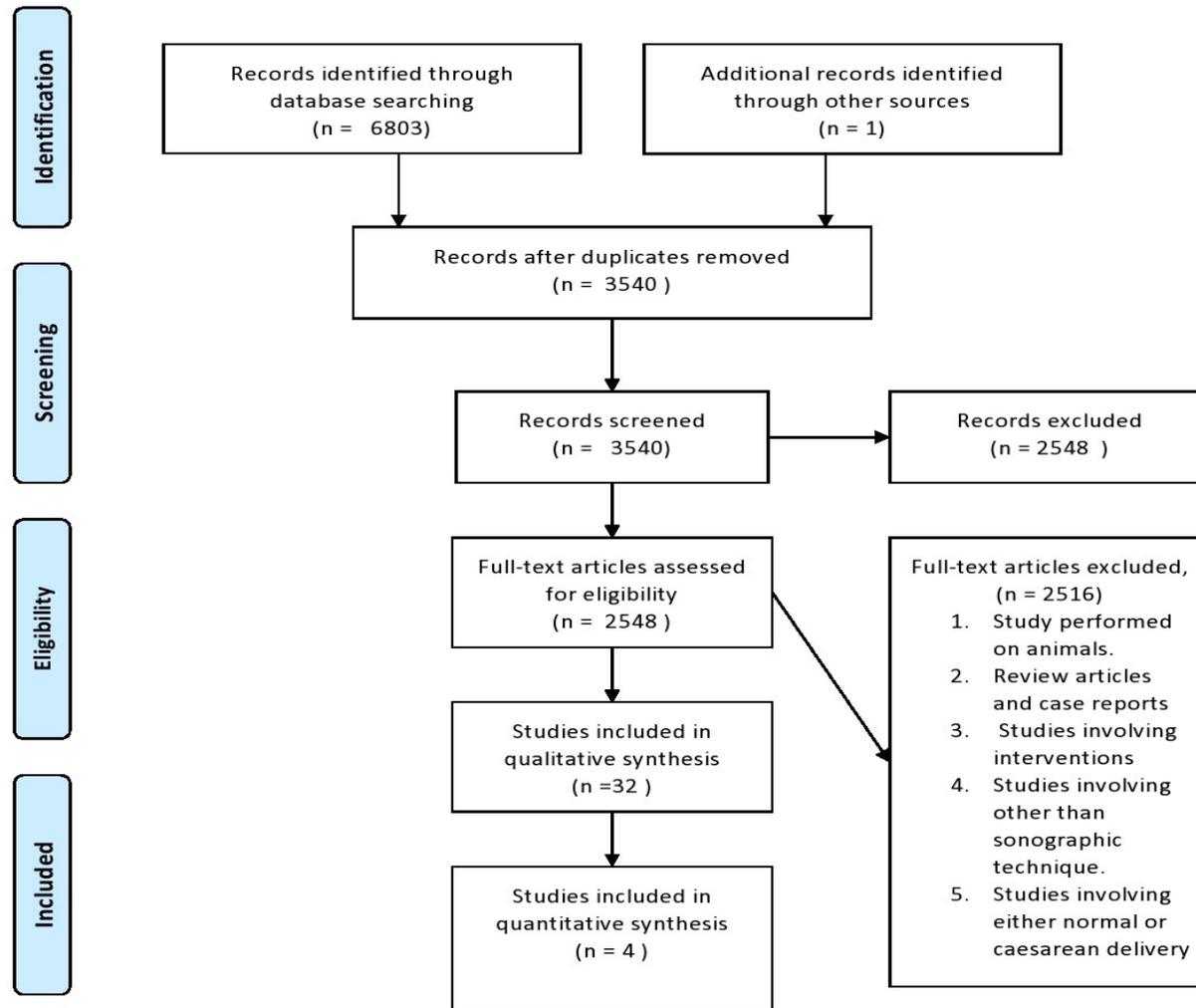
Figure 1: Selection of Studies according to PRISMA guidelines

Table 1: Description of the selected studies

Authors	Year of Study	Place of Study	Sample Size	Age Range	Period of Gestation	Mode of Delivery	Birth weight of neonate
Lousquy *et al.* [9]	2016	Department of gynecology and obstetrics, hôpital Lariboisière, Assistance publique—Hôpitaux de Paris	92 women	mean age was 32.7 years ± 5.4 (SD) (range 21—42 years)	Mean term at the time of delivery was 37.7 weeks gestation ± 1.1 (SD) (range 36—39.5 weeks)	61 vaginal deliveries and 31 cesarean deliveries	Mean birth weight was 3,457 g ± 450 (SD) (range 2,210—4,425 g)
Cilingir *et al.* [20]	2018	Trakya University, Faculty of Medicine, Department of Perinatology,Edirne, Turkey	47 women	mean age was 26.5 years (18–41 years)	Women who had delivered at ≥37 weeks were prospectiv-ely included	20 vaginal deliveries, whereas 27 cesarean deliveries	Mean birth weight for Vaginal delivery was 3275 ± 390 g and for cesarean delivery is 3085 ± 401 g
Brenner *et al.* [21]	2012	Department of Obstetrics and Gynecology,Chaim Sheba Medical Center	123 women	-	Mean gestational age at delivery-39.44 weeks (Range 37-42 weeks)	77 vaginal deliveries; 21 assisted vaginal deliveries (19 vacuum extraction and 2 forceps deliveries) and 25 cesarean deliveries	The birth weight ranged between 1885 and 4385 g (mean, 3291 g)
Kristoschek *et al.* [22]	2017	Hospital Universitário Antonio Pedro and Maternidade Municipal Alexander Fleming in the city of Rio de Janeiro, Brazil	91 women	mean age was 24 years (range 13–41 years)	-	54 vaginal deliveries, and 37 cesarean deliveries	average birth weight was 3,184 g (range 2,125–4,320 g); 20 infants weighed more than 3,500 g, and only 10 weighed less than 1,500 g

Table 2: Description of study and parity

Study	Parity
Lousquy *et al.* [9]	32 women were primiparous and 60 women were multiparous
Cilingir *et al.* [20]	16 women were primiparous and 31 women were multiparous
Brenner *et al.* [21]	52 women were primiparous and 34 delivered their second child and 37 had had 3 or more parturitions
Kristoschek *et al.* [22]	37 women were primiparous, 24 delivered their second child, and 30 had had 3 or more parturitions. The average number of children was 2.3.

Table 3: Showing duration of ultrasound

Study	Duration of Ultrasound
Lousquy *et al.* [9]	at 2 and 24 hour of delivery
Cilingir *et al.* [20]	At 24 hour of delivery
Brenner *et al.* [21]	within 48 hours of delivery
Kristoschek *et al.* [22]	On day 1, 2 and 7 after delivery

Table 4: Comparison of uterine dimensions

Study	Mode of Delivery	Uterine length (mm)	Uterine Volume (cm³)	Anterior wall thickness (mm)	Posterior wall thickness (mm)	Uterine width (mm)	Endometrial thickness (mm)
Lousquy *et al.* [9]	Vaginal delivery	At 2H-142 ± 18.2 [114—201] At 24H-139 ± 13.2 [106—175]		At 2H- 42 ± 7.5 [28—58] At 24H- 37 ± 7 [21—52]	At 2H- 44 ± 9.4 [21—61] At 24H- 42 ± 7.9 [25—67]	At 2H-115 ± 12.2 [88—140] At 24H-124 ± 13 [91—157]	At 2H- 11 ± 6.5 [2—33] At 24H- 8 ± 5.8 [1—36]
	Cesarean section	At 2H- 131 ± 14 [107—163] At 24H-131 ± 16.5 [96—158]		At 2H- 41 ± 7.2 [25—59] At 24H- 39 ± 8 [15—57]	At 2H- 43 ± 8.9 [27—62] At 24H- 42 ± 7 [27—58]	At 2H- 115 ± 12 [97—137] At 24H-119 ± 14.4 [90—159]	At 2H- 10 ± 5.9 [1—25] At 24H- 9 ± 5.7 [3—30]
Cilingir *et al.* [20]	Vaginal delivery	184.05 ± 16.8		34.7 ± 6.7	36.9 ± 7.9	123.3 ± 16.8	13.3 ± 6.3
	Cesarean section	163.6 ± 6.7		36.1 ± 6.4	34.8 ± 7.1	119.7 ± 12.4	12.5 ± 7.1
Brenner *et al.* [21]	Vaginal delivery	Normal Vaginal- 159.7 (94-214) Vacuum Extraction/Forceps-166.6 (131-194.7)	Normal Vaginal- 1579 (558-4066) Vacuum Extraction/Forceps- 1587 (989-2568)			Normal Vaginal- 82.7 (56-125) Vacuum Extraction/Forceps- 81.2 (51-174)	Normal Vaginal- 8.2(3-28) Vacuum Extraction/Forceps- 7.29(3.4-24)
	Cesarean section	170.3 (124-229)	1926 (907-3694)			90.4 (59-110)	8.64(3.2-16)
Kristoschek *et al.* [22]		D1-183 D3- 176 D7- 145	Vaginal delivery D1-852.6 D3-754.4 D7-467.8 Cesarean section D1-814.1 D3-663.0 D7-456.3			D1-125 D3- 118 D7-101	

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DISCUSSION

After the introduction of ultrasonography into the obstetric practice, [3] several authors have examined the uterus after vaginal delivery and/or cesarean section. Many authors focus on late puerperium and post delivery complications. Early postpartum period is more important in consideration to post partum haemorrhage. This period includes a week following delivery. During the search for eligible studies, it was found that many authors who have dealt with early post partum period had performed ultrasound on the first two days of delivery and didn't took whole 7 days into consideration [9, 20, 21]. Although most of the authors had trans-abdominal approach only few performed trans-vaginal sonography that too in the later period of post partum [22, 10]. As uterus is abdominal just after delivery so it justifies their approach criteria. Most of the authors have taken 2D sonography for evaluation [20] while Brenner *et al.* [21] took 2D as well as 3D sonography for diagnosis. Although, he mentioned that there were no any significant differences in their readings. Doppler sonography is also used by some authors for depicting the haemodynamic events during the puerperium as physiological process of involution happens not only in muscles and endometrial decidua

but also in arteries. Histological studies have shown that the normal involuted placental bed is characterized by trophoblasts disappearance and completely thrombosed spiral arteries [23, 24, 25].

All the selected studies were prospective and longitudinal. All studies reports the early abdominopelvic ultrasonographic findings in women with uneventful vaginal or cesarean delivery. While using Doppler sonography Lousquy *et al.* [9] observed a significant increase in uterine artery Resistive Index (RI) between 2 hours and 24 hours following delivery. This suggests physiological vasoconstriction of the uterine arteries. This study also shows that uterine length is more after vaginal delivery than cesarean delivery. However, they speculated that this was due to difference in units of oxytocin administration (15 vs 55). Cilinger *et al.* [20] also depicted the same results. The total doses of oxytocin administered during delivery and early puerperium were 35 and 45 units, respectively in their study. Uterine measurements were performed at 24 hours following delivery and none of the patients received oxytocin administration during the last 12 hours. Therefore, their findings could not be attributed to oxytocin usage. In contrast Brenner *et al.* [21] speculated that the uterine length is more after cesarean

delivery than vaginal delivery and it has been hypothesized that the contractions of uterus are more efficient and it stays firmer after vaginal delivery than after cesarean delivery. Kristoschek *et al*. **[22]** didn't demonstrate their results on the basis of comparison between both deliveries. They found that uterine length decreases by 3.9% on day 2 while it decreases considerably to 20.9% on day 7. Cilinger *et al*. **[20]** also found that the promontorium-fundus length and fundus-cervix length is more pronounced after vaginal delivery. None of the studies found significant difference in endometrial thickness. However, it was found thicker after 2 hours of delivery than at 24 hours of delivery and in vaginal delivery then cesarean delivery. But the difference was not significant. Cilinger *et al*. **[20]** hypothesized that the endometrial thickness up to 30 mm at 24 hours following vaginal or cesarean delivery is considered as normal finding.

Uterine width and RI of the arteries was found more after 24 hours of delivery than after 2 hours of delivery. In contrast anterior wall is found thicker after 2 hours of delivery than after 24 hours. Kristoschek *et al*. **[22]** analyzed that there is significant direct correlation between the influence of parity and the uterine volume.

CONCLUSION

Several authors have described routine ultrasonographic findings of the uterus after delivery. Some reported these findings after vaginal delivery while others after cesarean section. Also, the time-points of sonographic evaluations were heterogeneous. Knowledge of the normal appearance of the uterus and normal physiological uterine involution following childbirth seems quite important for radiologists and practitioners to avoid misdiagnosis. In one study, uterine volumes were obtained, but uterine dimensions were not compared according to mode of delivery **[22]**. One of the studies was the first to measure uterine dimensions in 3D ultrasonography but they hypothesized that the 3D sonography did not show an additional advantage over 2D sonography in the estimation of the puerperal uterus **[21]**. However, sonography along with Doppler assessment has added value in the clinical evaluation as it is able to also show residua in asymptomatic women. Another study depicted that the measurement of L5 to fundus distance is a simple and an effective technique to evaluate the puerperal uterus. It may be employed instead of a fundus to cervix measurement and other uterine dimensions **[20]**.

Through this study we tried to compare the sonographic changes in early post-partum period in normal vaginal and cesarean deliveries but this study has certain limitations. Due to non-funding, we limited our study to only open access journals. Studies that do not have English translation were excluded from the study. This provides scope for further research and systematic reviews.

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No any

REFERENCES

[1] Al-Bdour ANA, Akasheh HF, Al-Husban NA. Ultrasonography of the uterus after normal vaginal delivery. *Saudi Med J*. 2004; 25(1): 41-44.

[2] Obstetrics by Ten Teachers - Google Books. Accessed July 19, 2020.

[3] Donald I, Macvicar J, Brown TG. Investigation Of Abdominal Masses By Pulsed Ultrasound. *Lancet*. 1958; 271(7032): 1188-1195. doi:10.1016/S0140-6736(58)91905-6

[4] Zuckerman J, Levine D, McNicholas MMJ, *et al*. Imaging of pelvic postpartum complications. *Am J Roentgenol*. 1997; 168(3): 663-668.

doi:10.2214/ajr.168.3.9057511

[5] Plunk M, Lee JH, Kani K, Dighe M. Imaging of Postpartum Complications: A Multimodality Review. *Am J Roentgenol*. 2013; 200(2): W143-W154. doi:10.2214/AJR.12.9637

[6] Thomassin-Naggara I, Darai E, Bazot M. Gynecological pelvic infection: What is the role of imaging? *Diagn Interv Imaging*. 2012; 93(6): 491-499. doi:10.1016/j.diii.2012.04.002

[7] Kamaya A, Ro K, Benedetti NJ, Chang PL, Desser TS. Imaging and Diagnosis of Postpartum Complications. *Ultrasound Q*. 2009; 25(3): 151-162. doi:10.1097/RUQ.0b013e3181b5451e

[8] Shitami C, Takenaka K. Early puerperium involution of the uterus after Caesarian section: *J Japan Acad Midwifery*. 2016; 30(2): 333-341. doi:10.3418/jjam.30.333

[9] Lousquy R, Pernin E, Delpech Y, *et al*. Abdominopelvic ultrasonographic findings after uncomplicated delivery. *Diagn Interv Imaging*. 2016; 97(1): 45-51. doi:10.1016/j.diii.2014.12.003

[10] Mulic-Lutvica A. Postpartum

Ultrasound. *Donald Sch J Ultrasound Obstet Gynecol.* 2012; 6(1): 76-92. doi:10.5005/jp-journals-10009-1228

[11] Szoke B, Kiss D. The use of the ultrasonic echo technique in examining the normal and pathological involution in the puerperium. *Int J Gynecol Obstet.* 1977; 14(6): 513-516. doi:10.1002/j.1879-3479.1976.tb00097.x

[12] Rodeck CH, Newton JR. Study Of The Uterine Cavity By Ultrasound In The Early Puerperium. *BJOG An Int J Obstet Gynaecol.* 1976; 83(10): 795-801. doi:10.1111/j.1471-0528.1976.tb00747.x

[13] Wachsberg RH, Kurtz AB, Levine CD, Solomon P, Wapner RJ. Real-time ultrasonographic analysis of the normal postpartum uterus: Technique, variability, and measurements. *J Ultrasound Med.* 1994; 13(3): 215-221. doi:10.7863/jum.1994.13.3.215

[14] Malvern J, Campbell S, May P. Ultrasonic Scanning Of The Puerperal Uterus Following Secondary Postpartum Haemorrhage. *BJOG An Int J Obstet Gynaecol.* 1973; 80(4): 320-324.

doi:10.1111/j.1471-0528.1973.tb11199.x

[15] Lee C, Madrazo B, gynecology BD-O and, 1981 undefined. Ultrasonic evaluation of the postpartum uterus in the management of postpartum bleeding. *europepmc.org.* Accessed July 19, 2020. https://europepmc.org/article/med/6973109

[16] Haney E. Ultrasound examination of the postpartum uterus: What is normal? Thromboelastography in the TEG 6s-timing for running samples View project. *Artic J Matern Neonatal Med.* 2004; 15(2): 95-99. doi:10.1080/14767050310001650798

[17] Brown DL. Pelvic ultrasound in the postabortion and postpartum patient. *Ultrasound Q.* 2005;21(1):27-37. doi:10.1097/01.ruq.0000153465.03638.19

[18] Kirkinen P, Dudenhausen J, HB-TJ of, 1988 undefined. Postpartum blood flow velocity waveforms of the uterine arteries. *ncbi. nlm. nih.gov.* Accessed July 20, 2020. https://www.ncbi.nlm.nih.gov/pubmed/3050078

[19] Mulic-Lutvica A, Eurenius K, Axelsson O. Longitudinal study of Doppler flow resistance indices of the uterine arteries after normal vaginal delivery. *Acta Obstet Gynecol Scand*. 2007; 86(10): 1207-1214. doi:10.1080/00016340701621569

[20] Uzun Cilingir I, Sayin C, Sutcu H, et al. Comparison of postpartum sonographic findings after uneventful vaginal and cesarean section deliveries. *J Ultrason*. 2018; 18(75): 310-315. doi:10.15557/jou.2018.0045

[21] Weissmann-Brenner A, Haas J, Barzilay E, et al. Added Value of 3-Dimensional Sonography for Endometrial Evaluation in Early Puerperium. *J Ultrasound Med*. 2013; 32(4): 587-592. doi:10.7863/jum.2013.32.4.587

[22] Kristoschek JH, Moreira de Sá RA, da Silva FC, Vellarde GC. Avaliação ultrassonográfica da involução uterina no puerpério precoce. *Rev Bras Ginecol e Obstet*. 2017; 39(4): 149-154. doi:10.1055/s-0037-1601418

[23] Weydert JA, Benda JA. *Subinvolution of the Placental Site as an Anatomic Cause of Postpartum Uterine Bleeding A Review*. Vol 130.; 2006. doi:10.1043/1543-2165(2006)130[1538:SOTPSA]2.0.CO;2

[24] Andrew AC, Bulmer JN, Wells M, Morrison L, Buckley CH. Subinvolution of the uteroplacental arteries in the human placental bed. *Histopathology*. 1989; 15(4): 395-405. doi:10.1111/j.1365-2559.1989.tb01591.x

[25] Khong TY, Khong TK. Delayed postpartum hemorrhage: A morphologic study of causes and their relation to other pregnancy disorders. *Int J Gynecol Obstet*. 1994; 45(1): 74-74. doi:10.1016/0020-7292(94)90786-2