

The cervical length correlates with the amount of bleeding during cesarean section of the pernicious placenta previa

Shuhong Yang
Chen Cao
Qiang Li
Aiyue Luo
Lanfang Ma
Wanjiang Zeng
Ling Feng

Corresponding author:

Ling Feng
Department of Obstetrics and Gynecology,
Tongji Hospital, Tongji Medical College,
Huazhong University of Science and Technology,
Wuhan, China
E-mail: fltj007@163.com

*Co-corresponding author

Wanjiang Zeng
E-mail: wjzeng@tjh.tjmu.edu.cn

Abstract

Introduction: to investigate the association between the amount of bleeding during a cesarean section and the effacement of the uterine cervix in patients with pernicious placenta previa.

Methods: this study reviewed 50 singleton pregnancies with pernicious placenta previa. In cases of pernicious placenta previa, the cervical length were retrospectively measured and compared with the amount of bleeding during the cesarean section.

Results: there was a significantly negative correlation between the amount of bleeding and cervical length ($r = -0.390$, $P = 0.005$). The threshold cervical length associated with massive bleeding (>2500 mL) was 34.5mm, based on an ROC curve. Then, all cases were stratified by cervical length, ≤ 34.5 mm was defined as Group S, and 34.5 mm as Group L. The amount of bleeding in Group S was significantly larger than in Group L, and the length of hospital stay was longer in Group S. It was also found that hysterectomy after CS was significantly higher in Group S than in Group L. However, there were no significant differences in any of the other maternal demographics between the two groups.

Conclusion: this study demonstrated that a short cervical length, in cases with pernicious placenta

previa, was associated with massive bleeding during the operation. In addition, short cervical length seems to be one of the warning signs for massive bleeding and cesarean hysterectomy during the operation for pernicious placenta previa.

Key words: pernicious placenta previa, massive uterine bleeding, cervical length, cesarean section, ultrasound.

Introduction

As the incidence of cesarean section continues to rise worldwide, the problem of placenta previa/accreta is likely to become more common. Manyonda IT et al. (1) demonstrated that there is a high association of anterior placenta previa and placenta accreta with previous cesarean section. Consequently, massive obstetric hemorrhage occurs due to placenta previa/accreta with prior cesarean section. Realizing the fact that placenta previa is particularly dangerous when implanted on a lower uterine scar, Chattopadhyay SK (2) et al. reclassified placenta previa in order to highlight the increased risk. It was classified as follows: 1) placenta previa, without uterine scar or with scar but placenta lies clearly posteriorly; 2) pernicious placenta previa, where placenta overlies scar (i.e. anterior) one may or may not be accrete.

Massive bleeding often occurs during cesarean section in cases of placenta previa, especially in pernicious type. Prenatal prediction of high risk factors associated with excessive blood loss during a cesarean section would improve the preparation and management of the operation, for example, in the preparation of appropriate autotransfusion, balloon occlusion of the internal iliac arteries and a more intensive treatment. There are a number of papers which already described the predicting factors of placenta previa including cervical length (3). Although several ultrasonographic findings of short cervical length are associated with bad consequences such as emergency CS, cesarean hysterectomy, intraoperative blood loss and placental adherence/accreta in patients with placenta previa (3-7), there is no research work describing the predictive value of the cervical length for pernicious placenta previa.

Therefore, this study focused on the ultrasonographic findings of the cervix, and assessed their clinical usefulness as predictors for massive hemorrhage during a cesarean section in pernicious placenta previa.

Methods

Patients inclusion and data collection

A retrospective cohort study was performed at Tongji Hospital from January 2004 until April 2014. Cesarean sections were performed due to pernicious placenta previa complications in 50 cases.

Patients were excluded if they had 1) multiple gestations and 2) history of medical disorders complicating the pregnancy. This study is a retrospective analysis based on clinical records and ultrasonography that have been performed as a clinically required examination. Therefore, we pursued the complete protection of all personal data and confidentiality of the patients involved in this study, instead of obtaining the approval of our ethical board.

Emergency cesarean sections were performed when more than 100 mL of antepartum bleeding or uncontrollable uterine contractions occurred. Cesarean sections with placenta previa were executed by obstetricians with substantial experience. When physicians were faced with a possibly fatal hemorrhage, a hysterectomy was performed for life-saving treatment.

The sonographers obtain sagittal images with attention to these landmarks before voiding of the bladder: the cervical/vaginal interface, the internal cervical os, the external cervical os, the outline of the cervical corpus, and the full length of the cervical canal. These landmarks are similar to those used in other studies (8, 9). All examinations were performed using GE Voluson 730 or E8 machines (General Electric Healthcare, Wauwatosa, WI).

The amount of bleeding during cesarean section was determined based on the volume of blood suctioned off during the operation and the increase in the weight of the gauzes and packs used from the time of the skin incision to the time of wound closure. Massive bleeding was defined as ≥ 2500 mL and the bleeding included amniotic fluid also, since it was difficult to separate them accurately. When the hysterectomy was performed after the cesarean section, bleeding was measured during the entire procedure.

Statistical analysis

The data were recorded into a computerized analysis program (Statistical Package for Social Science (SPSS), Windows version 18.0). Continuous variables were compared using an independent sample t-test for the means. Categorical variables were reported as percentages and then were compared using the X²-test. Also, calculation of the correlation was made using Pearson's correlation coefficient and statistical significance was defined as a P-value <0.05 . The receiver operating characteristic (ROC) curve was determined based on the relationship between the sensitivities and false positive rates for the cervical lengths in massive bleeding of ≥ 2500 mL during the operation. The best cut-off point was evaluated according to the maximum likelihood ratio. Patients were divided into two groups: those with a short cervix (Group S) and others with a much longer one (Group L).

Results

A total of 50 women with pernicious placenta previa was included in the study group and among these cases, 28 had placenta accreta. Complete placenta previa occurred in 38 cases, partial in 3 cases, marginal in 6 cases and lower placenta in 3 cases. Moreover, hysterectomies were performed in only 3 cases and no cases with polyhydramnios or oligohydramnios were recorded. Emergency cesarean sections were performed before the date of the planned cesarean section in 10 patients (20%) either due to active antenatal bleeding or uterine contractions.

Figure 1 represents the correlation between the amount of bleeding during the cesarean section and a significant correlation was observed between the amount of bleeding and the cervical length ($r = -0.390$, $P=0.005$).

Figure 2 demonstrates the ROC curve, which indicates that 34.5 mm is the clinically useful cut-off point.

The cases were stratified by cervical length, ≤ 34.5 mm was defined as Group S, and >34.5 mm as Group L.

Table 1 shows the maternal demographics and complications in Group L and S. The amount of bleeding in Group S was significantly larger than in Group L and hysterectomy after CS was significantly higher in Group S than in Group L. In addition, the length of hospital stay in Group S was significantly longer than in Group L. However, there were no differences in any of the other maternal demographics between the two groups.

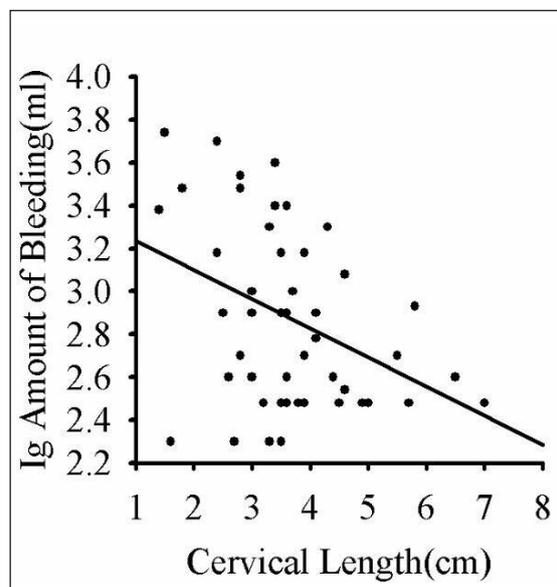


Figure 1.

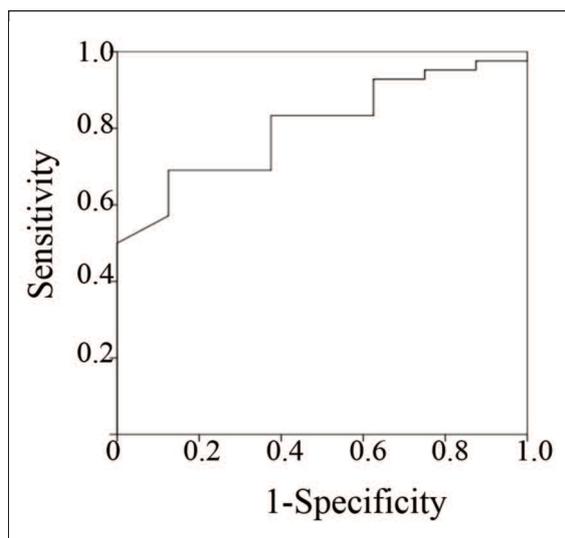


Figure 2.

Discussion

Pernicious placenta previa is an obstetric complication that results in a crisis situation for many patients. As the incidence of cesarean section continues to rise worldwide, the incidence of pernicious placenta previa is also increased. Since Chattopadhyay SK et al. (2) reclassified the placenta previa, more and more doctors pay attention to it, yet very few research work focus on it. Du et al. (10) has found an effective approach to reduce the amount of bleeding compared to that observed in regular surgeries in patients with pernicious placenta previa. They sutured the ascending branch of the uterine artery before delivery. This approach of suturing served as a preventive health measure in lieu of the standard approach in providing treatment in the puerperal stage. Chen et al. found that direct puncture embolization of the internal iliac artery during cesarean delivery was a safe, effective, simple, and rapid method to

Table 1 Maternal demographics and complications stratified by short and long cervical length.

	Cervical length <34.5mm (GS: n = 19)	Cervical length ≥34.5 mm (GL: n = 31)	P-value
Maternal demographics			
Maternal age (years)	32.7895±4.5287	32.8065±4.2459	0.989
Parity	2.1579±0.5015	1.9667±0.3198	0.109
Gravida	3.4737±1.3068	4.1333±1.5916	0.137
Number of earlier CS			0.062 ^a
≤1	15(78.9%)	30(96.7%)	
≥2	4(21.1%)	1(3.3%)	
Placental accreta ^b	15/19(78.9%)	13/31(41.9%)	0.018 ^a
Total placenta previa ^c	15/19	24/31	1.000 ^a
Hysterectomy after CS	3/19	0/31	0.049 ^a
Neonate transfer to NICU	4/19	6/31	1.000
Alarm bleeding	9/19	11/31	0.405
Amount of bleeding (mL)	1694.74±1550.08	751.61±568.11	0.003
Gestational week at delivery	36.1209±2.2260	36.2028±1.9556	0.904
Neonatal birth weight (g)	2883.5714±402.0832	2951.3043±402.5634	.6225
Scar thickness	2.7206±1.9583	3.5390±1.5874	0.117
Length of hospital stay	10.6316±4.5241	8.3548±2.5370	0.027
Dose of carboprost tromethamine	0.1111±0.1762	0.1389±0.1601	0.587
Dose of carbetocin	0.1333±0.1495	0.1444±0.1340	.796

^a As two cells have expected count less than 5, we use the Fisher's Exact Test.

^b Placenta accreta is defined as the abnormal attachment of the placenta to the myometrium. Abnormal placentation can be classified as placenta accreta when the chorionic villi attach to the myometrium, placenta increta when the villi invade the myometrium, and placenta percreta when the villi invade through the myometrium.

^c Except for total placenta previa, In GL group, partial in 1 case, marginal in 5 cases and lower placenta in 1 case ; In GS group, partial in 1 case, marginal in 1 case and lower placenta in 2 cases.

control hemorrhage among women with pernicious placenta previa and placenta accreta (11).

Likewise, we also tried to shed light on how to improve the outcome in pernicious placenta previa patients. Hence, keeping in mind that placenta previa is particularly dangerous when implanted on a lower uterine scar, and for avoiding catastrophic complications such as uterine rupture, massive vaginal bleeding and hysterectomy, it is prudent to identify the risk factors for it. Our research found that there was a significant correlation between the amount of bleeding and the cervical length. This indicates that a shorter CL is an important risk factor for pernicious placenta.

There are many studies on cervical length and its role on preterm hemorrhage, preterm labor and especially on placenta previa (5, 6, 12-14). Zaitoun et al. (4) found that a short cervical length at cut-off value ≤ 30 mm and an increased lower placental edge thickness might predict, with a high accuracy, the risk of antepartum hemorrhage and emergency preterm cesarean delivery in patients with complete placenta previa. Fukushima K et al. (3) reached a conclusion that cervical length should be included in the assessment of a placenta previa given its relationship to emergency CS, cesarean hysterectomy, intraoperative blood loss and placental adherence. In women with low-lying placenta persisting until the third trimester, short cervical length can be used as a predictor for antepartum bleeding (15). Our research agrees with these research findings mentioned above, which point out that the cervical length is closely related to blood loss in the perioperative period. Further analysis showed that 34.5 mm is the clinically useful cut-off point. This result was in agreement with the work of Pandipati S et al. which confirmed that a CL cut-off value of 35-36 mm was appropriate for detection of short cervix (16). Then the cases were stratified as Group S (≤ 34.5 mm) and Group L (> 34.5 mm). Regardless of the same incidence of total placental previa, a significant correlation was found between the amount of bleeding and the cervical length in the two groups. This suggests that there might be many causes of massive bleeding related to cervical effacement other than the types of placenta previa in cases with pernicious placenta previa.

Meanwhile, we found that the association between the uterus and the placenta (placenta accreta or none) was significantly different ($P=0.018$). The Group L had a lower morbidity (41.9%) than the Group S. Placenta accreta occurs when the whole placenta or part of it invades the myometrium in an abnormal way. As for the pathogenesis, defective decidualization during implantation is responsible. Abnormal placentation can be classified as (1) placenta accreta, when the chorionic villi attach to the myometrium, (2) placenta increta, when the villi invade the myometrium and (3) placenta percreta, when the villi invade through the myometrium. In this study, the general term "placenta accreta" is used to describe all 3 grades of abnormal placental attachment. This life-threatening obstetric complication happens in 533 out of 2510 childbirths. It is rapidly becoming a major

cause of obstetric complications worldwide and it is a major contributor to maternal morbidity and mortality, reflecting the recent escalation in the cesarean delivery rate. It accounts for 33-50% of all emergency peripartum hysterectomies (17). The identified risk factors for placenta accreta include both demographic (multiparity, age) and obstetric factors (previous uterine surgery or curettage, uterine infections, placenta previa, or operative delivery). In our study, we found that the cervical length was significantly associated with placenta accreta, which indicates a potential role for cervical length in the prediction of placental invasion. Similarly, Fukushima also proposed it is possible that some of the patients, with a shorter CL in the late 2nd or early 3rd trimester in placenta previa, may not be associated with cervical priming but placental insertion to lower part of the uterus (3). Women with a short cervix had a higher morbidity of placenta accreta in comparison to those with a longer cervical length. It is plausible that the invasion of the placenta could stimulate the effacement of the cervix and then the shorter cervix may secrete some molecules to accelerate the implantation.

A limitation of our study is that our study design did not allow us to determine the temporal relationship between cervical shortening and the development of complications. For example, it is not possible to know if placenta accreta preceded the development of a short cervix or whether the women first developed cervical shortening followed by placenta accreta. This is similar to the difficulties encountered in the diagnosis of cervical incompetence. A prospective study of serial cervical length measurements in women with placenta accreta would better address this issue. Future investigations might also better focus on a potential role for cervical length in the prediction of placental invasion.

The incidence of hysterectomy after CS was significantly different between the two groups. There were four hysterectomies performed in Group S while none in Group L. The cervical lengths of the four patients were 14, 18, 28 and 34 mm respectively, and their corresponding age was 28, 38, 38, 25 years old. All four patients had no hemorrhage before CS, and no myometrial involvement was observed in the lower uterine segment with the 3D ultrasound in three out of the four patients. One patient even had bladder repair surgery done. After the surgery, all of them were diagnosed as placenta accreta using biopsies. Hysterectomy is the most commonly performed procedure for the control of obstetric hemorrhage. Peripartum hysterectomy is generally performed in two scenarios, either to control massive bleeding, most often encountered for uterine atony, or for placenta accreta that was diagnosed antenatally. Many studies have found that placenta accreta was the most common reason for emergency peripartum hysterectomy, followed by uterine atony and uterine rupture (18, 19). In this study, three of the four patients had their hysterectomy done immediately after the delivery because of the uncontrolled hemorrhage. For the fourth

patient, bilateral uterine artery ligation was done first, but still bleeding could not be stopped and, so the uterus was removed. In the four cases with pernicious placenta previa, the placenta covers the scar and is located on the lower uterine segment through the cervical os; since the placental tissue is on the lower segment where the myometrial tissue is very thin or almost absent, contractions can be really difficult and weak. Reynolds et al. noted that the contractions had to start in the fundus and progressively propagate toward the cervix for uterine contractions to have the greatest efficiency, and that the strength of the contractions was greatest at the fundus and least at the cervix (20). So if the cervix is shortened, the lower segment would be widely extended and the contractions are likely to be weaker. Therefore, massive bleeding with pernicious placenta previa occurred more frequently and fatally. In our study, most patients with placenta accreta kept their uterus, one reason is that our department has exquisite surgical skills, the other is that our hospital has outstanding multidisciplinary team including an anesthesiologist, a blood bank team, a urologist in case bladder resection or repair is required, an intensivist for postpartum care, and an interventional radiologist if artery catheterizations were to be used.

For our patients, we chose transabdominal ultrasonography for detecting the CL. Women with singleton pregnancy that presented for a routine anomaly scan had their cervical length assessed transabdominally (TA), initially with the maternal bladder full (TABF) even though transvaginal ultrasonography (TV) is the gold standard for the diagnosis of placenta previa and has been demonstrated to be safe and more accurate (21). Marren AJ et al. (22) also suggested that all women should be offered a TV assessment of cervical length at the time of fetal anomaly ultrasound as a screening test for preterm birth. In addition, some researchers considered that TABF cannot avoid some technical problems, so it should not be recommended to measure cervical length (23). However, TV is not widely accepted in all locations and in our country, most pregnant women, especially those with abnormal placenta location, chose transabdominal ultrasonography (TA). As TABF is simple and acceptable, researchers have proved that it is an effective screening test for second-trimester placenta previa (21). Furthermore, Roh, H.J et al. found that TA cervical length measurements were correlated with TV measurements overall, hence TA could also be used as a cervical length screening tool (8, 24). Recently, Peng et al. (25) also made the same conclusion but directed more specifically to the cervical length screening in low-risk pregnant women.

Conclusion

In brief, our findings point out a possible association between cervical length and the amount of bleeding during the cesarean section in patients with pernicious placenta previa.

This has not been reported previously and may improve our ability to predict the clinical course and to refine obstetric management in these cases. The most important step in the prevention of major postpartum hemorrhage is recognizing and assessing women's risk. The risk of peripartum hysterectomy seems to be significantly decreased by limiting the number of cesarean deliveries, thus reducing the occurrence of pernicious placenta previa.

Competing interests

The Authors declare that they have no competing interests.

Acknowledgements

Financially supported by grants from the National Natural Science Foundation of China (no. 81501227).

References

1. Manyonda IT, Varma TR. Massive obstetric hemorrhage due to placenta previa/accreta with prior cesarean section. *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics*. 1991;34(2):183-186.
2. Chattopadhyay SK, Kharif H, Sherbeeni MM. Placenta praevia and accreta after previous caesarean section. *European journal of obstetrics, gynecology, and reproductive biology*. 1993;52(3):151-156.
3. Fukushima K, Fujiwara A, Anami A, Fujita Y, Yumoto Y, Sakai A, Morokuma S, Wake N. Cervical length predicts placental adherence and massive hemorrhage in placenta previa. *The journal of obstetrics and gynaecology research*. 2012;38(1):192-197.
4. Zaitoun MM, El Behery MM, Abd El Hameed AA, Soliman BS. Does cervical length and the lower placental edge thickness measurement correlates with clinical outcome in cases of complete placenta previa? *Archives of gynecology and obstetrics*. 2011;284(4):867-873.
5. Mimura T, Hasegawa J, Nakamura M, Matsuoka R, Ichizuka K, Sekizawa A, Okai T. Correlation between the cervical length and the amount of bleeding during cesarean section in placenta previa. *The journal of obstetrics and gynaecology research*. 2011;37(7):830-835.
6. Stafford IA, Dashe JS, Shivvers SA, Alexander JM, McIntire DD, Leveno KJ. Ultrasonographic cervical length and risk of hemorrhage in pregnancies with placenta previa. *Obstetrics and gynecology*. 2010;116(3):595-600.
7. Higgins MF, Monteith C, Foley M, O'Herlihy C. Real increasing incidence of hysterectomy for placenta accreta following previous caesarean section. *European*

- journal of obstetrics, gynecology, and reproductive biology. 2013;171(1):54-56.
8. Friedman AM, Schwartz N, Ludmir J, Parry S, Bastek JA, Sehdev HM. Can transabdominal ultrasound identify women at high risk for short cervical length? *Acta obstetrica et gynecologica Scandinavica*. 2013;92(6):637-641.
 9. Saul LL, Kurtzman JT, Hagemann C, Ghamsary M, Wing DA. Is transabdominal sonography of the cervix after voiding a reliable method of cervical length assessment? *Journal of ultrasound in medicine : official journal of the American Institute of Ultrasound in Medicine*. 2008;27(9):1305-1311.
 10. Du X, Xie X, Wang Y. Uterine artery suture: a preventive approach for pernicious placenta previa. *Cell biochemistry and biophysics*. 2014;68(2):407-410.
 11. Chen Z, Li J, Shen J, Jin J, Zhang W, Zhong W. Direct puncture embolization of the internal iliac artery during cesarean delivery for pernicious placenta previa coexisting with placenta accreta. *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics*. 2016;135(3):264-267.
 12. Tanvir, Ghose S, Samal S, Armugam S, Parida P. Measurement of cervical biometry using transvaginal ultrasonography in predicting preterm labor. *Journal of natural science, biology, and medicine*. 2014;5(2):369-372.
 13. Orzechowski KM, Boelig RC, Baxter JK, Berghella V. A universal transvaginal cervical length screening program for preterm birth prevention. *Obstetrics and gynecology*. 2014;124(3):520-525.
 14. Ghi T, Contro E, Martina T, Piva M, Morandi R, Orsini LF, Merigiola MC, Pilu G, Morselli-Labate AM, De Aloysio D et al. Cervical length and risk of antepartum bleeding in women with complete placenta previa. *Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology*. 2009;33(2):209-212.
 15. Curti A, Potti S, Di Donato N, Simonazzi G, Rizzo N, Berghella V. Cervical length and risk of antepartum hemorrhage in presence of low-lying placenta. *The journal of maternal-fetal & neonatal medicine: the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstet*. 2013;26(6):563-565.
 16. Pandipati S, Combs CA, Fishman A, Lee SY, Malloy K, Ivanovich F. Prospective evaluation of a protocol for using transabdominal ultrasound to screen for short cervix. *American journal of obstetrics and gynecology* 2015.
 17. Ekiz A, Polat I, Mumusoglu S, Aydinler B, Ozdemir C, Arslan HS. A case of placenta increta mimicking submucous leiomyoma. *Case reports in obstetrics and gynecology*. 2014;2014:429-406.
 18. Allam IS, Gomaa IA, Fathi HM, Sukkar GF. Incidence of emergency peripartum hysterectomy in Ain-shams University Maternity Hospital, Egypt: a retrospective study. *Archives of gynecology and obstetrics*. 2014;290(5):891-896.
 19. Kastner ES, Figueroa R, Garry D, Maulik D. Emergency peripartum hysterectomy: experience at a community teaching hospital. *Obstetrics and gynecology*. 2002;99(6):971-975.
 20. Reynolds SR, Hellman LM, Bruns P. Patterns of uterine contractility in women during pregnancy. *Obstetrical & gynecological survey*. 1948;3(5):629-646.
 21. Quant HS, Friedman AM, Wang E, Parry S, Schwartz N. Transabdominal ultrasonography as a screening test for second-trimester placenta previa. *Obstetrics and gynecology*. 2014;123(3):628-633.
 22. Marren AJ, Mogra R, Pedersen LH, Walter M, Ogle RF, Hyett JA. Ultrasound assessment of cervical length at 18-21 weeks' gestation in an Australian obstetric population: comparison of transabdominal and transvaginal approaches. *The Australian & New Zealand journal of obstetrics & gynaecology*. 2014;54(3):250-255.
 23. Larscheid P, Maass N, Kennes LN, Najjari L. (Transperineal ultrasound to measure cervical length of pregnant women in general and in particular with cervical insufficiency - a comparison of transabdominal and transperineal ultrasound as alternatives to transvaginal ultrasound). *Ultraschall in der Medizin*. 2015;36(1):59-64.
 24. Roh HJ, Ji YI, Jung CH, Jeon GH, Chun S, Cho HJ. Comparison of cervical lengths using transabdominal and transvaginal sonography in midpregnancy. *Journal of ultrasound in medicine: official journal of the American Institute of Ultrasound in Medicine*. 2013;32(10):1721-1728.
 25. Peng CR, Chen CP, Wang KG, Wang LK, Chen CY, Chen YY. The reliability of transabdominal cervical length measurement in a low-risk obstetric population: Comparison with transvaginal measurement. *Taiwanese journal of obstetrics & gynecology*. 2015;54(2):167-171.