



Perinatal outcomes of emergency and elective cervical cerclages

Aytaj Jafarzade^{a,*}, Sveta Aghayeva^a, Tamer M. Mungan^b, Aydan Biri^b, Elchin Jabiyev^c, Osman Ufuk Ekiz^d

^a Koru Hospital Ankara, Obstetrics and Gynaecology Department, Kızılırmak, 1450, Sk. No:13, 06510 Çankaya, Ankara, Turkey

^b Koru Hospital Ankara, Perinatology Department, Kızılırmak, 1450, Sk. No:13, 06510 Çankaya, Ankara, Turkey

^c Koru Hospital Ankara, Neonatal Intensive Care Unit, Kızılırmak, 1450, Sk. No:13, 06510 Çankaya, Ankara, Turkey

^d Gazi University, Statistic Department, Emniyet mah, Gazi Üniversitesi Rektörlüğü, Bandırma Cad, No:6/1, 06560 Yenimahalle, Ankara, Turkey

ARTICLE INFO

Keywords:

Cervical insufficiency
Cervical cerclage
Preterm birth
Emergency cerclage
Elective cerclage
Cervical shortening

ABSTRACT

Objective: This study aims to compare the perinatal outcomes of emergency and elective cervical cerclages.

Material and Methods: This retrospective study included a total of 247 patients, with a total of 142 emergency (with a history of mid-trimester miscarriage or vaginal delivery of < 34 weeks and cervical length < 25 mm) and 105 elective cerclage patients (with painless cervical dilation and cervical length < 25 mm) who had cerclage with the vaginal cervical McDonald technique between 1.1.2017–1.10.2022. Pregnant women with normal screening tests at weeks 11–14, normal fetal morphology, and singleton pregnancies were included in the study. The study was conducted in a tertiary center providing NICU care for < 1500 g, less than 32 weeks of age, and on a mechanical ventilator. Obstetric and perinatal outcomes were reviewed.

Results: There was no statistical difference between the two groups regarding maternal age or BMI. It was observed that the week of delivery was greater for elective cerclages than for emergency cerclages (mean 34.6 GW versus 30.8 GW). The week of cerclage application was statistically higher in emergency cerclage (19.2 GW versus 16.3 GW $p < 0.000$). In addition, when we evaluated perinatal complications: prenatal Ex (n34 vs. n8 $p < 0.001$), C-reactive protein which is a marker of neonatal infection (12.7 mg/L vs. 2.5 mg/L $p < 0.022$), antibiotic use in the NICU (n 35 vs. n23 $p < 0.050$), the number of days of antibiotic use in the NICU (mean 15.3 days vs. 10.4 days $p < 0.024$), rate of NICU intubation (n 27 vs. n 11 $p < 0.003$), and neonatal sequelae (n 16 vs. n 6 $p < 0.016$) were significantly higher in the emergency cerclage group than in the elective cerclage group. There was no found significant difference between the progesterone given and not given progesterone after the procedure in term of the weeks of delivery ($p < 0.810$ emergency cervical cerclage; $p < 0.681$ elective cervical cerclage)

Conclusion: Considering the available information, the results of elective cerclage seem to be more beneficial for the patient than those of emergency cerclage. Therefore, it would be more reasonable to perform elective cerclage in patients with mid-trimester or preterm miscarriage and concomitant cervical shortening before emergency cerclage is required. Furthermore, the benefit of progestin, in addition after surgical intervention, has not been established.

Introduction

Cervical insufficiency is when dilation and slackening of the cervix (25 mm or less) occur before 24 weeks gestation without contraction, bleeding, infection, rupture of the membranes, or labor [1]. It occurs in approximately 1% of all pregnancies [2].

The etiology of cervical insufficiency is unclear; however, risk factors include previous cervical surgery such as conization, repeated dilation,

and curettage, congenital abnormalities of the uterus, exposure to synthetic estrogen in utero, diethylstilbestrol, and possibly the most important risk factor [1]. Congenital causes are collagen synthesis pathologies - type I collagen regulatory disorders (Ehlers-Danlos syndrome) and uterine abnormalities [3,4]. Cerclage, the surgical treatment of cervical insufficiency, is divided into two types: abdominal (laparotomy, laparoscopic, and robotic) and vaginal. Shirodkar and McDonald are vaginal cervical cerclage techniques [5]. The choice depends on the

* Corresponding author.

E-mail address: jafarzade_aytac@yahoo.com (A. Jafarzade).

¹ ORCID: 0000-0002-2999-9992

surgeon's preference and the cervical condition of the pregnant woman. In this study, cerclage was performed using the McDonald technique. Birth before 34 weeks of gestation in the history and shortening and effacement of the cervix in the second trimester may indicate cervical cerclage in the next pregnancies [6]. Emergency cervical cerclage is the immediate surgical treatment of cervical shortening and effacement identified on examination [7].

This study aimed to analyze and compare the results of emergency and elective cervical cerclage in a tertiary referral center.

Materials and methods

The study was retrospectively designed and included patients who underwent cervical cerclage between 1/1/2017 and 1/10/2022. Ethics committee approval was obtained for the study. The study was conducted at Koru Ankara Hospital, which has approx. 4300–4400 deliveries per year and has mechanical ventilation facilities in Neonatal Intensive Care Unit (NICU) for less than 32 weeks and under 1500gr baby's. The patients' information, such as gravity, parity, number of living babies, column length, cervical dilation, gestational week, cerclage week, delivery week, and newborn well-being, were obtained from the patient records. Hospitalization in the NICU, infection parameters (CRP and procalcitonin PCT levels), antibiotic use, length of stay in the NICU, and neonatal complications were also evaluated. The indication for cerclage was made according to ACOG recommendations.

The diagnosis was made by obstetric history and transvaginal ultrasonography (Voluson 730 Expert). Patients were fully informed about the benefits of the procedure, alternative treatments, and complications, and informed consent was obtained. Elective cervical cerclage was applied at 11–15 weeks of gestation for pregnant women, who has a history of cervicale dilation and had a low risk in the first trimester screening test. Emergency cerclage was performed in patients who developed dilation and effusion (less than 25 mm) without pain during the examination, with or without a history of mid-trimester miscarriage, and in patients with a history of delivery < 34 weeks and cervical shortening (< 24 mm) before 24 weeks. Only singleton and vaginal cerclage patients were included in the study; twin pregnant women and patients with abdominal cerclage were excluded. In addition, patients with uterine contractions, painful cervical dilation, flaccidity, active vaginal bleeding, ruptured amniotic membranes on admission and ruptured amniotic membranes during or 48 h after the procedure. Signs of chorioamnionitis were excluded from the study. In this study, we set the limit of viability at 24 weeks or more.

The cerclage was performed in all patients using the McDonald technique. After bladder catheterization under sedo-analgesia, sterilization was performed with povidone-iodine. The patient was kept in the Trendelenburg position with collum ovarian forceps. In patients with prolapsed amniotic membrane, it was carefully pushed to the contents and sutured at 12, 9, 6, and 3'o clock levels with 5 mm Mersilene tape. All procedures were performed under the supervision of high-risk pregnancy specialists. Intravenous hydration and 2 g of intravenous cefazolin were administered preoperatively 1 h before the procedure. Postoperatively, all patients were monitored for 6 h by administration of rectal indomethacin and intramuscular 50 mg progesterone and then discharged. Cerclage removal occurred at 37 7/0 unless preterm labor began.

Results

Between 1/1/2017 and 1/10/2022, 468 patients were referred to our center with a diagnosis of cervical insufficiency. One hundred four patients received only medical treatment; 81 patients were excluded from the study as twin pregnancies; six underwent abdominal cerclage, and 247 underwent vaginal cerclage. A pessary was inserted in 30 patients with cervical insufficiency. The mean age of patients enrolled in the study was 30.8 (mean 20–42 SD±4.5), mean cervical length while

the procedure was 16.4 mm (mean 5–44 SD +6.3 mm), BMI was 23.9 (mean 18.9–31 SD +2.3), mean cervical dilation during the procedure was 26.8 mm (mean 10–50 SD +7.7 mm). Patients' mean week of pregnancy during the procedure was 15 (mean 12–23 SD +3.2). The mean delivery week after the procedure was 32.7 (mean 14–40 SD +6.4) weeks. Two hundred and four patients (83%) took progesterin after cerclage. When comparing the birth week with cervical length and cervical dilation, positive correlation was found between the birth week and cervical length ($r = 0.246$, $p = 0.000$). As the cervical length increased, the birth week also increased. There was no statistically significant association between a birth week and cervical dilation.

Emergency cerclage was performed in 57% (n 142) of patients and elective cerclage in 43% (n105). When evaluating the relationship between BMI and week of birth and perinatal outcomes, a very weak and positive relationship was found only between infants intubated in the neonatal intensive care unit ($r = 0.179$ $p = 0.015$); ($r = 0.178$, $p = 0.014$). In other words, the higher the BMI, the higher the likelihood of preterm birth, increasing the likelihood of infants being intubated.

The results of emergency and elective cerclages are compared in Table 1. When evaluated in term of gestational week in which the procedure was applied, the gestational week applied was found statistically large than in elective group, as expected. As can be seen, the week of use of the procedure was statistically longer in the patients who underwent emergency cerclage than in the elective group ($p < 0.000$). The delivery week for patients who underwent emergency cerclage was shorter than that of the elective group ($p < 0.000$). Cervical length was less in patients who underwent emergency cerclage than in the elective group ($p < 0.000$), and cervical dilation was higher than in the emergency group ($p = 0.002$). The delivery week was earlier in cases with more cervical dilation and effacement. The rate of progesterone use was higher in patients who underwent emergency cerclage group than elective group ($p = 0.048$). In addition, premature rupture of membranes was seen more frequently in the emergency cervical cerclage group and at earlier weeks compared to the elective cervical cerclage group. Graphic 1.

When comparing perinatal and postnatal findings in Table 2, the prenatal death rate, day of antibiotic use after hospitalization in the neonatal intensive care unit, intubation rate, CRP levels, and rate of development of neonatal sequelae were statistically higher in the emergency cerclage group than in the elective cerclage group. Although the rate of neonatal sequelae was higher in the emergency cerclage group, there was no significant difference between groups when assessed based on disease. There was no difference between the groups in the rate of NICU hospitalization, day of NICU hospitalization, or PCT value, there was no slight statistically significant difference between days of intubation ($p = 0.003$).

When comparing patients who underwent emergency and elective cerclage based on birth above viability (24 weeks or more), only a statistically significant difference was found between the groups regarding intubation and neonatal sequelae. Babies who underwent emergency cerclage and were born above viability were more likely to be intubated than the elective group ($p = 0.004$) Table 3.

These patients had a higher likelihood of developing neonatal sequelae ($p = 0.016$). Patients who underwent elective cerclage were more likely to be born above viability ($p = 0.0008$).

Table 1
Comparison of emergency and elective cerclage demographic characteristics.

	Emergency	Elective	P
Maternal age (mean)	30.5	31.6	0.069 ^t
BMI (mean)	23.95	23.99	0.911 ^m
Birth Week (mean)	30.8	34.6	0.000 ^m
Cervical dilatation (mean)	27.1	16.5	0.002 ^m
Cervical length (mean)	12.9	18.6	0.000 ^m
GW in Prosedure(mean)	19.2	15.5	0.000 ^t
Progesterone user	112	92	0.048 ^c
Amnion membrane rupture	31	12	0.001

Table 2
Evaluation of neonatal outcomes between both groups.

	Emergency	Elective	P
Prenatal Ex	34	8	0.001 ^c
Need for NICU hospitalization	39	26	0.081 ^c
NICU hospitalization day (Mean)	36	27.3	0.177 ^t
NICU antibiotic use	35	23	0.050 ^c
Birth Weight gr (Mean)	1290	2360	0.000 ^m
Antibiotic use day in NICU (Mean)	15.3	10.4	0.024 ^m
Need for intubation	27	11	0.003 ^c
Intubation day (Mean)	11.9	8.7	0.423 ^t
CRP (Mean)	12.7	2.5	0.022 ^m
PCT (Mean)	24.5	18.5	0.498 ^t
Neonatal sequelae	16	6	0.016 ^c
-BPD	8	3	0.121 ^f
-Stage I ROP	8	3	0.126 ^f
-Stage II ROP	5	2	0.270 ^f
-Seizure	1	0	0.490 ^f
-HIE	1	0	0.490 ^f
EX	8	2	0.099 ^f

^c Chi-Square test

^f Fischer's Exact test

^t t-test

Table 3
Comparison of perinatal and postnatal outcomes of patients born above the viability limit who underwent emergency and elective cerclage.

	Emergency	Elective	P
N	108	96	
Rate of being born above the viability limit. (%)	76	92.3	0.0008
Prenatal death	4	1	0.373
Need for NICU hospitalization	35	25	0.093
NICU hospitalization day (Mean)	38.2	27.5	0.141
Antibiotic use in NICU(Mean)	33	22	0.059
Antibiotic use day (Mean)	15.4	9.8	0.012
Intubation	25	10	0.004
Intubation day Mean)	11.9	7.3	0.285
CRP (Mean)	13.1	1.2	0.009
PCT (Mean)	22.5	17.8	0.360
Neonatal sequele	16	6	0.016
BPD	8	3	0.121
Stage I ROP	8	3	0.126
Stage II ROP	5	2	0.270
Seizure	1	0	0.490
HIE	1	0	0.490
EX	4	1	0.367

When 24 weeks of gestation was accepted as the viability limit, the rare of viability babies in the elective cervicale cerclage group was found to be higher than emergency groups(p = 0.0008).

When perinatal outcomes of patients who had undergone emergency cerclage were evaluated in 2 separate groups (progesterone users and non progesterone users), there was no difference in prenatal outcomes of the cases with progesterone supplementation compared to the cases without perinatal survival [Table 4](#).

Like wise, in elective cerclage cases, there was no difference in perinatal survival between progesterone administered and non-administered [Table 5](#). When we compared the patient groups with and without progesterone, we found that it did not prolong the duration of pregnancy in either group. [Table 6](#).

Discussion

Cervical insufficiency is a risk factor that promotes miscarriage and preterm delivery, which is increased neonatal mortality, and morbidity. The efficacy of cerclages, a surgical treatment option for cervical insufficiency, remains controversial. In this study, we compared the outcomes of emergency and elective cerclages.

Liddiard et al. also found no significant difference between the

Table 4
Comparison of perinatal outcomes in patients who underwent emergency cerclage with and without progesterone use.

	Progesterone user	Progesterone nonuser	p
Prenatal death	29	5	0.361
Need for NICU hospitalization (mean)	34	5	0.091
NICU hospitalization day (mean)	35.9	44	0.607
Antibiotic use in NICU(Mean)	31	4	0.070
Antibiotic use day (Mean)	15.8	11	0.432
Intubation	24	3	0.165
Intubation Day (Mean)	12.1	10.7	0.850
CRP (Mean)	13.9	4.4	0.426
PCT (Mean)	23.9	3.6	0.002
Neonatal sequele	18	3	0.385
BPD	7	0	0.338
Stage I ROP	6	1	0.471
Stage II ROP	4	2	0.640
Seizure	1	0	0.757
HIE	1	0	0.757
EX	7	1	0.672

^f Fischer's Exact test

^c Chi-Square test

^t t-test

Table 5
Comparison of perinatal outcomes in patients who underwent elective cerclage with and without progesterone use.

	PROGESTAN (+)	PROGESTAN (-)	p
Prenatal death	9	1	0.650
Need for NICU hospitalization (mean)	30	2	0.715
NICU hospitalization day (mean)	30.2	12	0.292
Antibiotic use in NICU(Mean)	27	2	0.477
Antibiotic use in NICU day (Mean)	10.8	10.5	0.920
Intubation	14	1	0.590
Intubation day (Mean)	9.5	4	0.486
CRP (Mean)	3.6	0.18	0.542
PCT (Mean)	19.8	7.9	0.588
Neonatal sequele	11	0	0.592 ^f
BPD	3	0	0.726
Stage I ROP	4	1	0.654
Stage II ROP	3	0	0.726
Seizure	0	0	-
HIE	0	0	-
EX	4	0	0.654

Table 6
Comparison of delivery week in patients who underwent elective cerclage with and without progesterone use.

	Progesterone user	Progesterone non-user	p
Emergency cerclage	Mean GW: 30.7Median GW: 34S.D. 7.1	Mean GW: 30.9Median GW: 34-35S.D. 7.3	0.810
Elective cerclage	Mean GW: 34.6Median GW: 37S.D. 4.9	Mean GW: 34.6Median GW: 36-37S.D. 5.1	0.681

emergency and elective cerclage groups regarding the gestational week, birth weight, live birth rate, or neonatal intensive care unit (NICU) requirements [8]. Our study found a statistically significant difference between emergency and elective cerclage birth weeks (p < 0.000) and live births (p < 0.001). In contrast, we found no statistically significant difference between the need for NICU (p < 0.081). In addition, the week of application of emergency cerclage was longer than that of elective cerclage (mean emergency cerclage 19.2; mean elective cerclage 16.3 p < 0000). Results are typical since emergency cerclage is placed as soon as cervical shortening is detected; however, it is placed at least 14–15

weeks before the week of elective cerclage.

The study by Chen et al. found that the birth week and birth weight were significantly lower in the emergency cerclage group, and the risk of membrane rupture was higher [9]. The results of our study were consistent with the results of this study. We also found lower birth weights in the emergency cerclage group ($p < 0.000$). This indicates that the success rate of emergency cerclage is lower than that of elective cerclage.

When postnatal findings in the emergency cerclage group were compared in our study, the prenatal mortality rate, day of antibiotic use after NICU hospitalization, intubation rate, CRP levels, and rate of development of neonatal sequelae were statistically higher in the emergency cerclage group than in the elective cerclage group. This is because the emergency cerclage group delivers earlier than the elective group, and the risk of infection is higher in the emergency cerclage group. Moreover, since microorganisms enter the amniotic sac after cervical dilation or dilation has occurred, we hypothesize that both rupture of the amniotic sac and infection markers (CRP and PCT) in the postnatal period, as well as the rate of antibiotic use in the neonatal intensive care unit and the days of antibiotic use, are longer in emergency cerclage. In addition, when neonatal sequelae (bronchopulmonary dysplasia, rop, HIE, convulsions) were studied, a higher rate of neonatal sequelae was found in the emergency cerclage group.

In some clinics, cerclage is used after amniocentesis has been performed prior to cerclage and microorganisms have been detected in the amniotic fluid. Meta-analyses have shown that cerclage is beneficial independently of amniocentesis [10]. Our clinic has no such approach, and the patients included in the study had not previously undergone amniocentesis.

In the study, vaginal progesterone was used by 112 of the 142 patients with emergency cerclages and by 92 of the 105 patients with elective cerclages. In the subgroup analysis, no difference was found between prenatal mortality, need for NICU, hospitalization rate, number of days in the NICU, and antibiotic use between patients with and without progesterone in both the emergency and elective cerclage groups. In addition, no significant difference was found between the potential neonatal sequelae.

Since progesterone decreases the preterm birth rate [11], although there is no difference between vaginal or intramuscular use [12], it was administered through the vagina to avoid the systemic effects of progesterone in our study. No association was found between progesterone use and birth week in either group. In their study, Cetingoz et al. [13] found that using progesterone reduced the need for an intensive care unit. In our study, no association was found with progesterone delivery week.

Many studies show that cerclage is more effective than bed rest treatment for cervical insufficiency [14,15,16]. A meta-analysis also concluded that emergency cervical cerclage is more effective than medical treatment [10]. In our study, we only compared the results of emergency cerclage with those of elective cerclage. In contrast to emergency cerclage, elective cerclage can be defined as a lower-risk procedure than emergency cerclage performed before cervical flaccidity under elective conditions at the end of the first trimester. It should be emphasized that despite the positive prognosis for cerclage treatment, the evidence is low because of the lack of randomized controlled trials. When we combine the results of previous meta-analyses with our study, cerclage seems more effective than waiting or drug treatment for cervical insufficiency. According to our data, it is more reasonable to perform elective cerclage in patients with mid-trimester miscarriage or preterm delivery and concomitant cervical insufficiency before cervical shortening occurs than to wait or treat medically. This is because when we compare the results of emergency cerclage and elective cerclage, elective cerclage seems to be more beneficial to the patient. The limitations of this study are that it was a retrospective, nonrandomized study that did not include abdominal cerclage patients and included only a small number of patients. However, the fact that it was conducted in the

same center and by or in the company of high-risk pregnancy specialists resulted in less heterogeneity in the clinical approach, which is a strength of the study. Another strength is that the study included not only patients with cervical shortening but also dilation, taking into account neonatal outcomes. This is because the fact that the membranes can be seen in the vagina on ultrasound is a finding that significantly reduces the success of cerclage [17]. Our study observed cervical dilation more frequently in the emergency group.

Our study also showed that the use of progesterone between the emergency and elective groups did not prolong the duration of labor. Although the study by Meis et al. [18] is one of the first conclusive studies on progesterone for the prevention of preterm birth, the major bias of this study is that 41.2% of the placebo group and 27.1% of the 17-oh progesterone group had a preterm birth. > They later published a PROLONG study [19] finding that progesterone did not prevent preterm labor in < 35 weeks of gestation. Although there are many studies on whether or not progesterone prevents preterm labor [18,20,21–22], this question remains unclear. However, ACOG recommends using 17OH-progesterone to prevent preterm pregnancies. In this study, the additional administration of progesterone during cervical cerclage had no effect on survival.

Conclusion

Thus, we agree that cerclage is a procedure that prevents preterm birth. However, according to the results of our study, the prenatal and postnatal outcomes of elective cerclage seem to be better than those of emergency cerclage. For this reason, we believe it is more appropriate to use elective cerclage in patients with preterm delivery or miscarriage in the 2nd trimester rather than leaving it as an observational treatment. The clinical contribution of this study appears to be that, consistent with this information, it would be beneficial for the patient to have elective cerclage performed before the need for emergency cerclage arises by seeking experienced centers rather than waiting until the patient is eligible for elective cervical cerclage. However, an emergency cerclage is an alternative if cervical shortening is noted during follow-up of patients with no previous history.

Compliance with Ethical Standards

Written approval from the Gazi University Ethics Committee, number E-77082166-604.01.02-537050, was obtained for the study. All authors have approved the manuscript submission, and the manuscript has not been published. It is not being considered for publication elsewhere, in whole or in part, in any language. This study was completed in accordance with the Declaration of Helsinki.

Funding

No Funding.

CRediT authorship contribution statement

Jafarzade Aytaj: Conceptualization, Data curation, Formal analysis, Investigation, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Aghayeva Sveta:** Project administration, Resources, Software, Supervision, Validation. **Mungan Tamer:** Conceptualization, Data curation, Methodology, Project administration, Resources. **Biri Aydan:** Conceptualization, Formal analysis, Investigation. **Ekiz Osman Ufuk:** Software, Supervision, Validation. **Jabiyev Elchin:** Data curation, Formal analysis, Methodology, Project administration, Resources.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this article.

References

- [1] American College of Obstetricians and Gynecologists. ACOG practice bulletin No.142: cerclage for the management of cervical insufficiency. *Obstet Gynecol* 2014;123:372–9.
- [2] Brown R, Gagnon R, Delisle MF. No. 373-cervical insufficiency and cervical cerclage. *J Obstet Gynaecol Can* 2019;41:233–47.
- [3] Romero R, Espinoza J, Erez O, Hassan S. The role of cervical cerclage in obstetric practice: can the patient who could benefit from this procedure be identified? *Am J Obstet Gynecol* 2006;194(1):1–9. <https://doi.org/10.1016/j.ajog.2005.12.002>.
- [4] Kimber-Trojnar Z. Management of concomitant cervical insufficiency and intrauterine adhesions. *Ann Transl Med* 2020;8:526. <https://doi.org/10.21037/atm.2020.03.137>.
- [5] Wood SL, Owen J. Cerclage: shirodkar, McDonald, and modifications. *Clin Obstet Gynecol* 2016;59:302–10.
- [6] Brown JA, Pearson AW, Veillon EW, Rust OA, Chauhan SP, Magann EF, et al. History- or ultrasound-based cerclage placement and adverse perinatal outcomes. *J Reprod Med* 2011;56:385–92.
- [7] Chatzakis C, Efthymiou A, Sotiriadis A, Makrydimas G. Emergency cerclage in singleton pregnancies with painless cervical dilatation: a meta-analysis. *Acta Obstet Gynecol Scand* 2020;99:1444–57. <https://doi.org/10.1111/aogs.13968>.
- [8] Liddiard A, Bhattacharya S, Crichton L. Elective and emergency cervical cerclage and immediate pregnancy outcomes: a retrospective observational study. *JRSM Short Rep* 2011;2:91.
- [9] Chen Q, Chen G, Li N. Clinical effect of emergency cervical cerclage and elective cervical cerclage on pregnancy outcome in the cervical-incompetent pregnant women. *Arch Gynecol Obstet* 2018;297:401–7.
- [10] Chatzakis C, Efthymiou A, Sotiriadis A, Makrydimas G. Emergency cerclage in singleton pregnancies with painless cervical dilatation: a meta-analysis. *Acta Obstet Gynecol Scand* 2020;99(11):1444–57.
- [11] Dodd JM, Jones L, Flenady V, Cincotta R, Crowther CA. Prenatal administration of progesterone for preventing preterm birth in women considered to be at risk of preterm birth. Jul 31 *Cochrane Database Syst Rev* 2013;(7):CD004947. <https://doi.org/10.1002/14651858.CD004947>.
- [12] Romero R, Nicolaides K, Conde-Agudelo A, Tabor A, O'Brien JM, Cetingoz E, et al. Vaginal progesterone in women with an asymptomatic sonographic short cervix in the midtrimester decreases preterm delivery and neonatal morbidity: a systematic review and metaanalysis of individual patient data. *Am J Obstet Gynecol* 2012;206(124):e1–19.
- [13] Cetingoz E, Cam C, Sakalli M, et al. Progesterone effects on preterm birth in high-risk pregnancies: a randomized placebocontrolled trial. *Arch Gynecol Obstet* 2011; 283:423–9.
- [14] Aoki S, Ohnuma E, Kurasawa K, Okuda M, Takahashi T, Hirahara F. Emergency cerclage versus expectant management for prolapsed fetal membranes: a retrospective, comparative study. *J Obstet Gynaecol Res* 2014;40(2):381–6.
- [15] Ciavattini A, Delli Carpini G, Boscarato V, Febi T, Di Giuseppe J, Landi B. Effectiveness of emergency cerclage in cervical insufficiency. *J Matern Fetal Neonatal Med* 2016;29(13):2088–92.
- [16] Ehsanipoor RM, Seligman NS, Saccone G, et al. Physical examination-indicated cerclage. *Obstet Gynecol* 2015;126:125–35.
- [17] Jalal EM, Moretti F, Gruslin A. Predictors of outcomes of non-elective cervical cerclages. *J Obstet Gynaecol Can* 2016;38(3):252–7.
- [18] Meis PJ, Klebanoff M, Thom E, Dombrowski MP, Sibai B, Moawad AH, Spong CY, Hawth JC, Miodovnik M, Varner MW, Leveno KJ, Caritis SN, Iams JD, Wapner RJ, Conway D, O'Sullivan MJ, Carpenter M, Mercer B, Ramin SM, Thorp JM, Peaceman AM, Gabbe S, National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. Prevention of recurrent preterm delivery by 17 alpha-hydroxyprogesterone caproate. *N Engl J Med* 2003; 348(24):2379–85. Jun 12.
- [19] Blackwell SC, Gyamfi-Bannerman C, Biggio Jr JR, Chauhan SP, Hughes BL, Louis JM, Manuck TA, Miller HS, Das AF, Saade GR, Nielsen P, Baker J, Yuzko OM, Reznichenko GI, Reznichenko NY, Pekarev O, Tatarova N, Gudeman J, Birch R, Jozwiakowski MJ, Duncan M, Williams L, Krop J. 17-OHPC to prevent recurrent preterm birth in singleton gestations (PROLONG Study): a multicenter, international, randomized double-blind trial. *Am J Perinatol* 2020;37(2):127–36 (Jan).
- [20] Ning A, Vladutiu CJ, Dotters-Katz SK, Goodnight WH, Manuck TA. Gestational age at initiation of 17-alpha hydroxyprogesterone caproate and recurrent preterm birth. *Am J Obstet Gynecol* 2017;217:371. e1–7.
- [21] Saghafi N, Khadem N, Mohajeri T, Shakeri MT. Efficacy of 17alpha-hydroxyprogesterone caproate in prevention of preterm delivery. *J Obstet Gynaecol Res* 2011; 37:1342–5.
- [22] Nelson DB, McIntire DD, McDonald J, Gard J, Turricchi P, Leveno KJ. 17-alpha hydroxyprogesterone caproate did not reduce the rate of recurrent preterm birth in a prospective cohort study. *Am J Obstet Gynecol* 2017;216:600. e1–9.