SPMC JHCS

RESEARCH

Bacterial growth in placental swab cultures done among women who received ampicillin prophylaxis for term prelabor rupture of membranes: matched cohort study

Melissa Corinales-Lomod,[1] Sigrid Aguirre-Barinaga[1,2,3,4,5,6,7,8]

[1]Department of Obstetrics & Gynecology, Southern Philippines Medical Center, JP Laurel Ave, Davao City, Philippines

[2]Department of Obstetrics & Gynecology, Davao Doctors Hospital, E Quirino Avenue, Davao City, Philippines

[3]Department of Obstetrics & Gynecology, Brokenshire Integrated Health Ministries Inc, Brokenshire Heights, Madapo, Davao City, Philippines

[4]Department of Obstetrics & Gynecology, San Pedro Hospital of Davao City Inc, C Guzman St, Davao City, Philippines

[5]Community Health and Development Cooperative Hospital, Anda Riverside, Davao City, Philippines

[6]Davao Medical School Foundation Hospital, Medical School Drive, Bajada, Davao City, Philippines

[7]Metro Davao Medical & Research Center Inc, JP Laurel Ave, Davao City, Philippines

[8]Ricardo Limso Medical Center, Ilustre St, Poblacion District, Davao City, Philippines

Correspondence
Melissa Corinales-Lomod
melissa.corinales@yahoo.com

Article editors
Josefa Dawn Martin
Michael Casas

Received
24 January 2017

Accepted
8 September 2017

Published online
31 December 2017

Cite as
Corinales-Lomod M, Aguirre-Barinaga S. Bacterial growth in placental swab cultures done among women who received ampicillin prophylaxis for term prelabor rupture of membranes: matched cohort study. *SPMC J Health Care Serv.* 2017;3(2):6. http://n2t.net/ark:/76951/jhcs26b8tm

ABSTRACT

Background. Term prelabor rupture of membranes (PROM) increases the risk of maternal and neonatal infections.
Objective. To compare rates of positive bacterial growth in placental swab cultures done among women who received ampicillin prophylaxis at different timings after term PROM.
Design. Matched cohort study.
Setting. Department of Obstetrics and Gynecology at Southern Philippines Medical Center in Davao City, Philippines.
Participants. 120 pregnant women aged ≥18 years old, at ≥37 weeks age of gestation, with PROM: 40 women received ampicillin within 6 hours (6H group), 40 within >6 to 12 hours (12H group), and 40 within >12 to 18 hours (18H group) of onset of PROM.
Main outcome measures. Rates of positive bacterial growth in postpartum placental swab cultures; most common bacterial isolates; and signs of intraamniotic infection (IAI).
Main results. Women in the 6H group, 12H group, and 18H group did not significantly differ in terms of clinical characteristics at baseline. None of the women developed clinical IAI. Positive bacterial growth were observed in 27/40 (67.5%) of cultures in the 6H group, 31/40 (77.5%) of cultures in the 12H group, and 31/40 (77.5%) of cultures in the 18H group. Across all groups, the five most common isolates were *Escherichia coli, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus epidermidis,* and *Enterobacter cloacae*.
Conclusion. Rates of positive bacterial growth in placental swab cultures did not significantly differ among groups of women who received ampicillin at different timings within 18 hours from onset of term PROM.

Keywords. placental swab culture, bacterial isolates, intraamniotic infection, ampicillin prophylaxis

INTRODUCTION

Compared to pregnant women with rupture of membranes after the onset of labor, those with prelabor rupture of membranes (PROM; also known as premature rupture of membranes) at term have higher rates of both maternal and neonatal infections.[1] Prophylactic antibiotic administration during term PROM prevents these infections.[2-4]

Women with PROM for 12 hours are at higher risk of intraamniotic infection (IAI), and those with PROM for 16 hours are at higher risk of endometritis.[5] Fetal complications, such as low APGAR score and neonatal sepsis, can also happen after IAI.[6] Antibiotic prophylaxis is commonly indicated when labor begins or is induced 12 hours after PROM,[3 4 7] but some question its usefulness when administered to women with term PROM.[8-10]

There has been no consensus as regards the optimal timing of prophylactic antibiotic administration to women with term pregnancies complicated by PROM. In our setting, obstetricians prescribe antibiotics on admission as prophylaxis for IAI. Patients with term PROM in our institution therefore receive antibiotics as early as 6 hours from rupture of membranes.

We wanted to check bacterial growth in placental swab cultures from postpartum women after prepartum antibiotic administration. We hypothesized that, the sooner antibiotics are given to pregnant women after PROM, the lower the rate of intraamniotic bacterial growth that can possibly lead to clinical infection. We did this study in order to compare bacterial growth in placental swab

IN ESSENCE

Prelabor rupture of membranes during term pregnancy (term PROM) can cause maternal and neonatal infections.

In this study among women who received ampicillin prophylaxis within 18 hours of term PROM, the rates of positive bacterial growth in postpartum placental swab cultures were similar, regardless of timing of ampicillin administration.

Antibiotic prophylaxis for term PROM should at least cover common bacterial isolates—*Escherichia coli, Staphylococcus spp.*, and *Enterobacter cloacae*—and should start within 18 hours from rupture of membranes.

cultures done among women given ampicillin prophylaxis at different timings after term PROM.

METHODOLOGY

Study design and setting

We did a matched cohort study from March to September 2016 at the Department of Obstetrics and Gynecology in Southern Philippines Medical Center in Davao City. The department admits an average of 13,600 patients per annum for delivery, and an average of 16% of these patients have a diagnosis of term PROM. In our institution, patients with term PROM usually receive 2 grams of intravenous ampicillin on admission and every six hours thereafter until delivery.

Participants

Patients aged 18 years or older, at or after 37 weeks age of gestation, with self-reported rupture of membranes but in latent phase of labor, with live singleton pregnancy in vertex presentation, admitted to deliver in our institution, who received at least one dose of 2 grams of intravenous ampicillin upon admission, and who gave informed consent were eligible to participate in the study. We purposively recruited 40 consecutive eligible patients whose membranes ruptured within 6 hours of administration of ampicillin (6H group), another 40 consecutive eligible patients whose membranes ruptured more than 6 hours up to 12 hours of administration of the antibiotic (12H group), and another 40 consecutive eligible patients whose membranes ruptured more than 12 hours up to 18 hours of administration of ampicillin (18H group).

Data collection

We gathered information on the patients' age, gravidity, and parity, as well as on white blood cell (WBC) and C-reactive protein (CRP) elevations on admission, prior to antibiotic administration. We also collected data on signs of infection (fetal tachycardia from admission to delivery, and maternal fever, maternal tachycardia, uterine tenderness, and foul odor vaginal discharge all throughout the patient's stay), as well as complications such stillbirth and postpartum hemorrhage.

Collection of specimen from the delivered placenta was done by swabbing the chorion-amnion interface using a sterile cotton pledget and putting the swab in a cooked meat medium. The swab was then inoculated in MacConkey and blood agar plates. The plates were incubated at 37 degrees Celsius for 24 hours. MacConkey plates and half of the blood agar plates were stored in an aerobic environment, while the rest of the blood agar plates were stored in an anaerobic environment. Bacterial colonies noted within 24 hours were subsequently identified.

The main outcome measures for this study were the presence of bacterial growth and the identification of the most commonly isolated bacteria from the cultures. We also tested the susceptibility of the isolates to selected antibiotics. Across all groups, we also looked at the proportions of patients with maternal signs of infection (i.e., tachycardia, fever, uterine tenderness, foul odor vaginal discharge), fetal tachycardia, stillbirth, and postpartum hemorrhage.

Statistical analysis

We used Epi Info™ 7.1.4.0 to analyze the data for this study. Continuous variables were summarized as means ± standard deviations and compared using ANOVA. Categorical variables were summarized as frequencies and percentages, and compared using chi-square. We set the level of significance at <0.05.

RESULTS

A total of 120 patients were included in this analysis. Table 1 shows the baseline characteristics of the patients per exposure group. The three groups were comparable in terms of mean age, mean gravidity, and mean parity. The frequencies of elevated WBC and elevated CRP did not significantly differ across exposure groups.

Table 2 shows the comparative frequencies of outcomes of the three exposure groups. All groups were comparable in terms of prepartum symptoms. One patient from the 6H

Table 1 Patients' characteristics on admission

Characteristics	6H* n=40	12H* n=40	18H* n=40	p-value
Mean age ± SD, *years*	25.40 ± 5.82	25.98 ± 5.98	26.35 ± 6.12	0.7742
Mean gravidity ± SD	1.92 ± 1.49	1.73 ± 1.09	2.10 ± 1.93	0.5555
Mean parity ± SD	0.74 ± 1.41	0.58 ± 0.78	0.98 ± 1.82	0.4430
Elevated WBC, *frequency (%)*	1 (2.5)	5 (12.5)	4 (10.0)	0.2422
Elevated CRP, *frequency (%)*	6 (15.0)	12 (30.0)	10 (25.0)	0.2713

*6H (≤6 hours), 12H (>6 hours up to 12 hours), or 18H (>12 hours up to 18 hours) from rupture of membranes to ampicillin administration.
CRP—C-reactive protein; WBC—white blood cells.

Table 2 Clinical and placental swab culture outcomes

Parameters	Frequency (%) 6H*	12H*	18H*	p-value
Maternal tachycardia	0	1 (2.5)	0	0.3648
Fetal tachycardia	1 (2.5)	0	0	0.3648
Maternal fever	0	0	0	1.0000
Uterine tenderness	0	0	0	1.0000
Foul odor vaginal discharge	0	0	0	1.0000
Postpartum hemorrhage	2 (5.0)	0	0	0.1308
Stillbirth	0	1 (2.5)	0	0.3648
Positive placental swab culture	27 (67.5)	31 (77.5)	31 (77.5)	0.4986

*6H (≤6 hours), 12H (>6 hours up to 12 hours), or 18H (>12 hours up to 18 hours) from rupture of membranes to ampicillin administration.

group had fetal tachycardia and one patient from the 12H group had maternal tachycardia. None of the patients in the study had maternal fever, uterine tenderness or foul odor vaginal discharge. One patient in the 12H group had stillbirth, and two patients in the 6H group had postpartum hemorrhage. However, none of the clinical outcomes had statistically significant difference in frequencies across the three groups. A total of 89/120 (74.17%) patients had positive placental swab cultures. The frequencies of positive placental swab cultures were similar across all groups (p=0.4986).

Isolates from the placental swab cultures are listed in Table 3. Across all groups, the five most common organisms isolated were *Escherichia coli, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus epidermidis,* and *Enterobacter cloacae*. One placental swab culture from the 6H group and another one from the 12H group grew methicillin-resistant *Staphylococcus aureus* (MRSA). The antibiotic susceptibility patterns of the five most common organisms and MRSA are summarized in Table 4.

DISCUSSION

Key results

In this study, the frequencies of bacterial growth in placental swab cultures did not significantly differ across exposure groups given ampicillin prophylaxis at different timings after term PROM. The most common bacterial isolates from the placental swab cultures were *Escherichia coli, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus epidermidis,* and *Enterobacter cloacae.*

Strengths and limitations

We were able to demonstrate bacterial growth

Table 3 Bacterial isolates from patients with positive placental swab cultures

6H* n=27		12H* n=31		18H* n=31	
Organism†	Frequency	Organism†	Frequency	Organism†	Frequency
Escherichia coli	8	*Escherichia coli*	10	*Escherichia coli*	10
Staphylococcus hominis	4	*Staphylococcus hominis*	4	*Staphylococcus hominis*	3
Staphylococcus haemolyticus	2	*Enterobacter cloacae*	3	*Acinetobacter spp.*	2
Staphylococcus epidermidis	2	*Staphylococcus epidermidis*	3	*Bacillus spp.*	2
Bacillus spp.	2	*Staphylococcus haemolyticus*	3	*Enterobacter cloacae*	2
Candida krusei	1	*Staphylococcus sciuri*	2	*Klebsiella pneumoniae*	2
Enterobacter cloacae	1	*Pseudomonas putida*	2	*Pseudomonas stutzeri*	2
Enterococcus faecalis	1	*Bacillus spp.*	1	*Staphylococcus epidermidis*	2
Grimontia hollisae	1	*Klebsiella pneumoniae*	1	*Staphylococcus haemolyticus*	2
Klebsiella pneumoniae	1	*Micrococcus luteus*	1	*Acinetobacter lwoffii*	1
Kocuria kristinae	1	MRSA	1	*Aeromonas spp.*	1
Kocuria rosea	1	*Pseudomonas mendocina*	1	*Candida non-albicans*	1
Micrococcus luteus	1	*Staphylococcus aureus*	1	*Enterococcus faecalis*	1
MRSA	1	*Staphylococcus capitis*	1	*Staphylococcus warneri*	1
Staphylococcus aureus	1	*Staphylococcus warneri*	1		
Staphylococcus capitis	1				
Staphylococcus epidermidis	1				

*6H (≤6 hours), 12H (>6 hours up to 12 hours), or 18H (>12 hours up to 18 hours) from rupture of membranes to ampicillin administration.
†one placental swab culture may grow more than one bacterial species.
MRSA—methicillin-resistant *Staphylococcus aureus*.

Table 4 Antibiotic susceptibility patterns for the five most common bacterial isolates and MRSA from 89 patients with positive placental swab cultures

	Escherichia coli				*Staphylococcus hominis*				*Staphylococcus haemolyticus*				*Staphylococcus epidermidis*				*Enterobacter cloacae*				MRSA			
Antibiotic	**n***	**S**	**I**	**R**	**n***	**S**	**I**	**R**	**n***	**S**	**I**	**R**	**n***	**S**	**I**	**R**	**n***	**S**	**I**	**R**	**n**	**S**	**I**	**R**
Amikacin	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	-	6	6	0	0	-	-	-	-
Ampicillin	27	19	0	8	-	-	-	-	-	-	-	-	-	-	-	-	6	0	0	6	-	-	-	-
Ampicillin + sulbactam	22	21	1	0	-	-	-	-	-	-	-	-	-	-	-	5	-	0	0	5	-	-	-	-
Azithromycin	-	-	-	-	1	0	0	1	1	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Aztreonan	28	28	0	0	10	3	0	7	6	3	0	3	5	4	0	1	6	6	0	0	2	2	0	0
Cefepime	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	-	6	6	0	0	-	-	-	-
Cefotaxime	28	28	0	0	-	-	-	-	-	-	-	-	1	1	0	0	4	4	0	0	-	-	-	-
Cefoxitin	28	28	0	0	11	3	0	8	7	1	0	6	6	2	0	4	6	0	0	6	2	0	0	2
Ceftazidime	27	27	0	0	-	-	-	-	-	-	-	-	-	-	-	6	-	5	0	1	-	-	-	-
Ceftriaxone	27	27	0	0	-	-	-	-	-	-	-	-	-	-	-	6	-	5	0	1	-	-	-	-
Cefuroxime	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	6	-	2	0	4	-	-	-	-
Ciprofloxacin	28	28	0	0	11	11	0	0	7	7	0	0	7	7	0	0	6	6	0	0	2	2	0	0
Clindamycin	2	2	0	0	10	4	0	6	7	6	0	1	7	6	0	1	-	-	-	-	2	2	0	0
Coamoxiclav	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	6	-	0	0	6	-	-	-	-
Cotrimoxazole	24	16	0	8	11	8	0	3	7	5	0	2	7	4	0	3	6	4	0	2	2	1	0	1
Ertapenem	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	6	-	5	1	0	-	-	-	-
Erythromycin	-	-	-	-	11	3	2	6	7	4	0	3	7	4	0	3	-	-	-	-	2	2	0	0
Gentamicin	27	27	0	0	11	11	0	0	7	7	0	0	7	6	0	1	6	6	0	0	2	2	0	0
Imipenem	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	-	6	6	0	0	-	-	-	-
Levofloxacin	26	26	0	0	11	11	0	0	7	7	0	0	6	6	0	0	6	6	0	0	2	2	0	0
Linezolid	-	-	-	-	11	11	0	0	7	7	0	0	7	7	0	0	-	-	-	-	2	2	0	0
Meropenem	28	28	0	0	-	-	-	-	-	-	-	-	-	-	-	-	6	6	0	0	-	-	-	-
Ofloxacin	-	-	-	-	9	9	0	0	6	6	0	0	7	7	0	0	-	-	-	-	2	2	0	0
Oxacillin	-	-	-	-	7	3	0	4	6	1	0	5	7	3	0	4	-	-	-	-	2	0	0	2
Penicillin	-	-	-	-	11	1	0	10	7	0	0	7	7	3	0	4	-	-	-	-	2	0	0	2
Piperacillin	12	11	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Piperacillin + tazobactam	23	23	0	0	-	-	-	-	-	-	-	-	-	-	-	-	5	4	0	1	-	-	-	-
Rifampicin	-	-	-	-	10	10	0	0	7	7	0	0	7	6	0	1	-	-	-	-	2	2	0	0
Tazobactam	5	5	0	0	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0	0	-	-	-	-
Tetracycline	-	-	-	-	10	9	0	1	7	5	0	2	7	5	0	2	-	-	-	-	2	0	0	2
Tobramycin	27	27	0	0	-	-	-	-	-	-	-	-	-	-	-	-	6	6	0	0	-	-	-	-
Vancomycin	-	-	-	-	9	9	0	0	7	7	0	0	7	7	0	0	-	-	-	-	2	2	0	0

*n varies because not all isolates were tested for susceptibility with every antibiotic available, and not all antibiotics were available every time an isolate was tested for susceptibility.
I—intermediate susceptibility; R—resistant; S—susceptible.

in postpartum placental swab cultures from women who received ampicillin prophylaxis within 18 hours after term PROM. None of our patients developed clinical intraamniotic infection, but this finding underscores the importance of early administration of antibiotic prophylaxis to women with term PROM. There were some limitations in this study. Amniotic fluid culture is the gold standard for diagnosing intraamniotic infection,[11] but we did not include this as a study procedure. We only relied on postpartum placental swab culture to establish the presence of bacteria in the placenta, and yet we could not get data on bacterial loads of isolates, either. We did not include data on labor induction, and we did not account for the actual doses of ampicillin given to the patients and the time from PROM to delivery. These elements in the management of patients with term PROM can possibly affect bacterial growth in the placental swab cultures. Finally, apart from determining the presence of fetal tachycardia, we did not collect other parameters that can possibly establish the presence of fetal or neonatal infections related to PROM.

Interpretation

Term PROM is the rupture of membranes before labor at or after 37 weeks of gestation.[12] When labor is not induced, spontaneous delivery will usually occur in 70% of women within 24 hours and in 85% of women within 48 hours of rupture of membranes.[13] The condition can induce cord prolapse, cord compression, placental abruption, various deformities due to oligohydramnios, and/or mechanical difficulties during delivery.[14 15] Moreover, women with term PROM are at high risk of IAI.[14 16 17] Clinical IAI is diagnosed when a pregnant woman with PROM has fever, accompanied by at least two of the following: uterine tenderness, maternal or fetal tachycardia, and purulent or foul odor vaginal discharge.[18 19] In our study, none of our patients had clinical IAI. The administration of antibiotics on admission could have prevented any latent or clinical infection in at least some of our patients.

Antibiotics are generally recommended 18 hours after rupture of membranes.[20 21] Most pregnant women with term PROM in our institution all receive ampicillin prophylaxis upon admission, prior to delivery. We wanted to know if, despite administration of antibiotics, there would still be bacterial growth in postpartum placental swab cultures and, if there was, we wanted to check whether growth varied in frequency according to timing of antibiotic administration from the onset of rupture of membranes. Our results revealed that 67.5-77.5% of the placental swab cultures demonstrated bacterial growth despite prepartum administration of ampicillin prophylaxis to women with PROM. Bacterial growth was present in cultures from placenta of women who were given antibiotic prophylaxis as early as <6 hours after rupture of membranes. The timing of antibiotic administration in relation to the onset of rupture of membranes did not significantly affect the proportion of patients with positive placental swab culture.

Intraamniotic infection after rupture of membranes usually happens through ascending bacterial invasion by aerobic and anaerobic organisms from the vagina.[17] Many organisms can cause infection of the placenta, but the most common are beta-hemolytic streptococci, *Staphylococcus aureus, Escherichia coli,* and *Listeria monocytogenes*.[22-24] *Streptococcus viridans, Staphylococcus spp., Enterobacter cloacae,* and *Gardnerella vaginalis* have also been isolated in placenta from women who gave birth to preterm neonates.[25]

In this study, *Escherichia coli* turned out to be the most common organism isolated from the placenta, followed by *Staphylococcus hominis, Staphylococcus epidermidis, Staphylococcus haemolyticus* and *Enterobacter cloacae*. Two placental swab cultures also grew MRSA. *Escherichia coli* and *Enterobacter cloacae* are gram negative rods that are normally seen in the human intestine,[26] while *Staphylococcus epidermidis* is part of the normal flora of the human skin, respiratory tract, and gastrointestinal tract,[27] but they can become pathogenic when they reach other tissues.

Routine prophylactic antibiotic administration to pregnant women at the time of term PROM can significantly reduce maternal and neonatal infectious morbidity.[28] However, judicious use of antibiotic should be ensured since there is an increasing incidence of bacterial resistance,[29] and—although rare—life-threatening maternal anaphylaxis can occur with antibiotic use.[30]

In our institution, we usually use ampicillin as prophylactic antibiotic for women with term PROM. In this study, only 19 out of 27 *Escherichia coli* isolates were susceptible to ampicillin. Based on available data from the antibiotic susceptibility patterns of the five most common bacterial isolates from patients with positive placental swab cultures, the antibiotics that the organisms are most susceptible to are ciprofloxacin and levofloxacin. Four of the five organisms were also 100% susceptible to gentamicin. Quinolones like ciprofloxacin and levofloxacin are generally not used during pregnancy.[31] Both ciprofloxacin and levofloxacin are classified as Pregnancy Category C by the United States Food and Drug Administration.[32] Gentamicin can be combined with ampicillin to treat IAI.[33] This regimen is also useful in preventing or treating neonatal sepsis, which is a complication of PROM.[34 35]

Generalizability

These results support the practice in our institution of giving antibiotic prophylaxis to pregnant women with term PROM upon admission. The antibiotic of choice should at least cover *Escherichia coli, Staphylococcus spp.*, and *Enterobacter cloacae*, the most common bacterial isolates, and should be given as soon as possible, preferably within 18 hours from rupture of membranes. Obstetric practitioners in facilities similar to ours may consider our findings when managing pregnant

women with term PROM who come to the facility right after rupture of membranes.

CONCLUSION

The rates of positive bacterial growth in placental swab cultures were similar across patient groups who received ampicillin prophylaxis at different timings (within 6 hours, more than 6 to 12 hours, and more than 12 hours to 18 hours) in relation to onset of term PROM. The most common bacteria isolated from the placental swab cultures were *Escherichia coli, Staphylococcus hominis, Staphylococcus haemolyticus, Staphylococcus epidermidis,* and *Enterobacter cloacae*.

Acknowledgments

We extend our heartfelt gratitude to the following: Dr Helen Grace Te-Santos for her guidance in the initiation of this research; Dr Maria Lourdes Cabling for her assistance during the conduct of this research; Dr Maria Elinore Concha, Dr Rojim Sorosa, and Dr Gilbert Vergara for their inputs in the design of this research; the laboratory staff and Obstetrics-Gynecology residents of Southern Philippines Medical Center for their participation in the implementation of this research; and Dr Lynnette Lasala, Dr Loida Michelle Ong, Mr Roel Ceballos, and Mr Clyde Vincent D Pacatang for their inputs during the preparation of this report.

Ethics approval

This study was reviewed and approved by the Department of Health XI Cluster Ethics Review Committee (DOH XI CERC reference P15072501).

Reporting guideline used

STROBE Checklist (http://www.strobe-statement.org/fileadmin/Strobe/uploads/checklists/STROBE_checklist_v4_combined.pdf)

Article source

Submitted

Peer review

External

Funding

This research was supported partly by a grant from the Department of Health Region XI and partly by personal funds of the authors.

Competing interests

None declared

REFERENCES

1. Xia H, Li X, Liang H, Xu H. The clinical management and outcome of term premature rupture of membrane in East China: results from a retrospective multicenter study. Int J Clin Exp Med. 2015;8(4):6212-7.

2. Barišić T, Mandić V, Tomić V, Zovko A, Novaković G. Antibiotic prophylaxis for premature rupture of membranes and perinatal outcome. The Journal of Maternal-Fetal & Neonatal Medicine. 2017;30(5):580-4.

3. Cararach V, Botet F, Sentis J, Almirall R, Perez-Picanol E, onProm C. Administration of antibiotics to patients with rupture of membranes at term: A prospective, randomized, multicentric study. Acta Obstetricia et Gynecologica Scandinavica. 1998 Jan 1;77(3):298-302.

4. Passos F, Cardoso K, Coelho AM, Graca A, Clode N, Mendes da Graca L. Antibiotic prophylaxis in premature rupture of membranes at term: a randomized controlled trial. Obstet Gynecol. 2012;120(5):1045-51.

5. Tran SH, Cheng YW, Kaimal AJ, Caughey AB. Length of rupture of membranes in the setting of premature rupture of membranes at term and infectious maternal morbidity. Am J Obstet Gynecol. 2008;198(6):700.e1-5.

6. Perez-Munoz ME, Arrieta MC, Ramer-Tait AE, Walter J. A critical assessment of the "sterile womb" and "in utero colonization" hypotheses: implications for research on the pioneer infant microbiome. Microbiome. 2017;5(1):48.

7. Schrag S, Gorwitz R, Fultz-Butts K, Schuchat A. Prevention of perinatal group B streptococcal disease. Revised guidelines from CDC. MMWR Recomm Rep. 2002;51(Rr-11):1-22.

8. Saccone G, Berghella V. Antibiotic prophylaxis for term or near-term premature rupture of membranes: metaanalysis of randomized trials. Am J Obstet Gynecol. 2015;212(5):627.e1-9.

9. Nabhan AF, Elhelaly A, Elkadi M. Antibiotic prophylaxis in prelabor spontaneous rupture of fetal membranes at or beyond 36 weeks of pregnancy. Int J Gynaecol Obstet. 2014;124(1):59-62.

10. Norwitz ER, Greenberg JA. Antibiotics in Pregnancy: Are They Safe? Rev Obstet Gynecol. 2009;2(3):135-6.

11. Committee Opinion No. 712. American College of Obstetricians and Gynecologists. Obstet Gynecol. 2017;130:e95–101.

12. Jazayeri A. Premature rupture of membranes. Medscape. 2017 December [cited 2017 December 31]. Available from: https://emedicine.medscape.com/article/261137-overview.

13. Keirse MJ, Ottervanger HP, Smit W. Controversies: prelabor rupture of the membranes at term: the case for expectant management. J Perinat Med. 1996;24(6):563-72.

14. Enkin M, Keirse MJ, Neilson J, Crowther C, Duler L, Hodnett E, et al. A guide to effective care in pregnancy and childbirth. 3rd ed. Oxford: Oxford University Press; 2000.

15. The Royal Australian and New Zealand College of Obstetricians and Gynecologists. Term prelabour rupture of membranes (term PROM) [Internet]. Melbourne; 2016 [cited 2017 December 31]. Available from: https://www.ranzcog.edu.au/RANZCOG_SITE/media/RANZCOG-MEDIA/Women%27s%20Health/Statement%20and%20guidelines/Clinical-Obstetrics/Term-Prelabour-Rupture-of-Membranes-(Term-Prom)-(C-Obs-36)-review-2017.pdf?ext=.pdf.

16. Tran SH, Cheng YW, Kaimal AJ, Caughey AB. Length of rupture of membranes in the setting of premature rupture of membranes at term and infectious maternal morbidity. Am J Obstet Gynecol. 2008;198(6):700.e1-5.

17. American College of Obstetricians and Gynecologists. Intrapartum management of intraamniotic infection. Obstet Gynecol. 2017;130:e95–101.

18. Tita ATN, Andrews WW. Diagnosis and Management of Clinical Chorioamnionitis. Clin Perinatol. 2010;37(2):339-54.

19. Villar J, Papageorghiou A, Knight H, Gravett M, Iams J, Waller S, et al. The preterm birth syndrome: a prototype phenotypic classification. American Journal of Obstetrics and Gynecology. 2012;206(2):119-123.

20. Schrag S, Gorwitz R, Fultz-Butts K, Schuchat A. Prevention of perinatal group B streptococcal disease: Revised guidelines from CDC. Centers for Disease Control and Prevention. 2002 August;51(RR11):1-22.

21. Kliegman R, Stanton B, Schor N, St. Geme J, Behrman R. Nelson textbook of Pediatrics. 19th ed. Philadelphia: Elsevier Saunders; 2011.

22. Sorano S, Goto M, Matsuoka S, Tohyama A, Yamamoto H, Nakamura S, et al. Chorioamnionitis caused by Staphylococcus aureus with intact membranes in a term pregnancy: A case of maternal and fetal septic shock. J Infect Chemother. 2016;22(4):261-4.

23. McClure EM, Dudley DJ, Reddy U, Goldenberg RL. Infectious causes of stillbirth: A clinical perspective. Clin Obstet Gynecol. 2010;53(3):635-45.

24. Bhola K, Al-Kindi H, Fadia M, Kent AL, Collignon P, Dahlstrom JE. Placental cultures in the era of peripartum antibiotic use. Aust N Z J Obstet Gynaecol. 2008 Apr;48(2)179-84.

25. Kornete A, Vedmedovska N, Blazuka S. Correlation between placental pathology and neonatal morbidity: a case-control study. Int J Reprod Contracept Obstet Gynecol. 2017 Feb:6(2):599-605.

26. Carroll K, Hobden J, Miller S, Morse S, Mietzner T, Detrick B, et al. Enteric Gram-Negative Rods (Enterobacteriaceae). In: Jawetz, Melnick, & Adelberg's Medical Microbiology. 27th ed. New York: McGraw-Hill; 2016. p. 231-246.

27. Carroll K, Hobden J, Miller S, Morse S, Mietzner T, Detrick B, et al. The Staphylococci. In: Jawetz, Melnick, & Adelberg's Medical Microbiology. 27th ed. New York: McGraw-Hill; 2016. p. 203-212.

28. Flenady V, King J. Antibiotics for prelabour rupture of membranes at or near term. The Cochrane Collaboration Database of Systematic Reviews. 2002.

29. Wojcieszek AM, Stock OM, Flenady V. Antibiotics for prelabour rupture of membranes at or near term. Cochrane Database of Systematic Reviews. 2014.

30. Heim K, Alge A, Marth C. Anaphylactic reaction to ampicillin and severe complication in the fetus. Lancet. 1991:337(8745):859-60.

31. Walker RC, Wright AJ. The fluoroquinolones. Mayo Clin Proc. 1991;66(12):1249-59.

32. Antibiotic use during pregnancy and lactation. Am Fam Physician. 2006 Sep;74(6):1035.

33. Stiglich N, Alston M, vanSwam S. Optimizing treatment of intra-amniotic infection and early-onset postpartum endometritis: advantages of single-agent therapy. Perm J. 2011;15(3):26-30.

34. Simonsen KA, Anderson-Berry AL, Delair SF, Davies HD. Early-onset neonatal sepsis. Clinical Microbiology Reviews. 2014;27(1):21-47.

35. National Collaborating Centre for Women's and Children's Health (UK). Antibiotics for early-onset neonatal infection: antibiotics for the prevention and treatment of early-onset neonatal infection. London: RCOG Press; 2012 Aug.