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Predictors for poor maternal and neonatal outcomes in parturients with intrapartum fever: a case-control study

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Objective: This study aims to determine the predictors for intrapartum fever and for poor maternal and neonatal outcomes in parturients with intrapartum fever, and to evaluate the pathogens involved and their resistance to antibiotics.
Methods: Medical records of patients with intrapartum fever and singleton delivery at term in Tuen Mun Hospital, Hong Kong between 1 July 2020 and 31 June 2021 were retrieved. Each patient was matched with a consecutive healthy control by parity and gestational age. The case and control groups were compared in terms of composite adverse maternal and neonatal outcomes. Multivariate analyses were used to determine predictors for intrapartum fever and for poor maternal and neonatal composite outcomes. Pathogens isolated from maternal, placental, and neonatal specimens were evaluated, as was their resistance to antibiotics.
Results: The incidence of intrapartum fever was 4.4% (164/3729). In multivariate analysis, predictors for intrapartum fever were hypertensive disease (adjusted odds ratio [aOR]=7.42, p=0.015), epidural analgesia (aOR=6.22, p<0.001), and duration of ruptured membranes (aOR=1.07, p=0.044). Epidural analgesia was a predictor for composite adverse maternal outcome (aOR=2.65, p=0.007), whereas maternal temperature of ≥39°C was a predictor for composite adverse neonatal outcome (aOR=5.15, p=0.036). Positive bacterial culture was not associated with poor neonatal outcomes. Higher degrees of maternal temperature were associated with higher composite maternal and neonatal morbidity. 89 (54.3%) of febrile patients had positive culture results. *Enterococcus* was the most common gram-positive organism (48.1%) and *Escherichia coli* was the most common gram-negative bacteria (65.2%).
Conclusion: Intrapartum fever is associated with poor maternal and neonatal outcomes. Obstetricians should avoid long duration of labour and high maternal temperature. The choice of antibiotics for intrapartum fever/chorioamnionitis should be carefully selected, with consideration of efficacy, possible adverse effects, and antimicrobial resistance.

Keywords: Chorioamnionitis; Fever; Infant, newborn; Maternal health

Introduction

Intrapartum fever is defined as a maternal body temperature of ≥38°C during labour. Its prevalence ranges from 1.6% to 14.6% of deliveries[1]. Chorioamnionitis is suspected when the maternal temperature is ≥39°C alone or 38.0°C to 38.9°C plus presence of other risk factors[2]. Intrapartum fever/chorioamnionitis negatively affects obstetric and neonatal outcomes. Intrapartum fever can be caused by infections such as chorioamnionitis, pyelonephritis, respiratory infection, and viral infection[3]. It can also be triggered by non-infectious causes such as epidural analgesia, environment temperature changes, and prostaglandin use during induction of labour. The aetiology of most maternal fever cases is more likely to be non-infectious, particularly resulting from epidural analgesia[4]. Nevertheless, obstetricians usually start treatment once intrapartum fever is detected even when chorioamnionitis is not evident yet.

Intrapartum fever is highly associated with adverse maternal outcomes (postpartum haemorrhage, labour dystocia, operative vaginal delivery, caesarean delivery, endometritis, and sepsis) and increased risks of neonatal morbidities (low Apgar scores, respiratory distress, neonatal sepsis, meconium aspiration, and neonatal intensive care unit admission)[1,3,5-8]. This study aims to determine the predictors for intrapartum fever and clinical factors that lead to poor maternal and neonatal outcomes in parturients with intrapartum fever, and to evaluate the pathogens involved and their resistance to antibiotics.

Materials and methods

Medical records of patients with intrapartum fever and singleton delivery at term in Tuen Mun Hospital,

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Hong Kong between 1 July 2020 and 31 June 2021 were retrieved from the labour ward registry and cross-checked with neonatal ward registry. Intrapartum fever is defined as at least one measurement of ≥38°C during labour. Tympanic temperature was measured every 4 hours during intrapartum period, at the end of the second stage of labour, and at 1 hour after delivery. Elevated temperature was confirmed with repeated testing on another ear. Patients with fever were assessed by medical officers and treated with empirical intravenous antibiotics (ampicillin or clindamycin [if allergic to penicillin]). Basic septic workup included cultures of vaginal swabs and placental swabs. The placenta was examined histopathologically. Maternal blood was cultured for those with high fever or signs of acute chorioamnionitis. Prophylactic antibiotic (intravenous ampicillin 1 g every 6 hours) was given during labour for those with prolonged rupture of membranes (>18 hours) or known Group B *Streptococcus* carriers. Neonates of febrile women were assessed by paediatricians, and routine septic workup for neonates included ear swab, gastric lavage, and blood culture.

Each patient was matched with a consecutive healthy control by parity and gestational age. Those with pregnancy complications (non-vertex presentation, multiple pregnancy, preterm delivery <37 weeks, known fetal chromosomal or structural anomalies, pre-labour fever on admission), contraindication for vaginal delivery, elective caesarean section, and 'born before arrival to hospital' were excluded, as were those without intrapartum fever but developed pyrexia just after delivery.

Composite adverse maternal outcomes included emergency caesarean delivery, postpartum haemorrhage (≥500 ml), blood transfusion, intensive care unit admission, prolonged hospitalisation (>3 days for vaginal delivery and >5 days for caesarean delivery), and hospital readmission within 6 weeks of delivery. Composite adverse neonatal outcomes included 1-min Apgar score of <4, 5-min Apgar score of <7, umbilical cord blood pH of <7.1, resuscitation at birth, neonatal intensive care unit admission, mechanical ventilation, meconium aspiration, transient tachypnoea of newborn, respiratory distress syndrome, haemodynamic instability, clinical sepsis, pneumonia, necrotising enterocolitis, and meningitis. The diagnosis of sepsis was made if signs of systemic infection (unstable body temperature, feeding intolerance, respiratory distress, acidosis, and increased C-reactive protein or white cell counts) were detected.

Data analysis was performed using the SPSS (Windows version 26; IBM Corp, Armonk [NY], United States). The case and control groups were compared using the *t* test and Mann-Whitney *U* test for continuous variables and the Chi-squared test or Fisher's exact test for discrete variables. Multivariate logistic regression model was used to determine predictors for intrapartum fever and adverse maternal and neonatal outcomes. A p value of <0.05 was considered statistically significant.

Results

During the study period, 3729 live babies were delivered, including 74 pairs of twins. The incidence of intrapartum fever was 4.4% (164/3729). The 164 patients with intrapartum fever were compared with controls matched for gestational age and parity (Table 1). The two groups were comparable in terms of ethnicity, smoker, Group B *Streptococcus* carrier, body mass index, and rates of diabetes in pregnancy and prelabour rupture of membranes. More patients with intrapartum fever had advanced maternal age (≥35 years) [22.0% vs 12.2%, p=0.019] and hypertensive disease in pregnancy (13.4% vs 1.2%, p<0.001). Patients with intrapartum fever had a longer duration of ruptured membranes (median, 12 vs 6 hours, p<0.001) and a longer labour duration (median, 8 vs 5 hours, p<0.001), were more likely to have epidural analgesia, induction of labour, emergency caesarean delivery, and intrapartum antibiotic use (all p<0.001), were less likely to deliver spontaneously (31.1% vs 59.1%, p<0.001), with a higher rate of caesarean delivery (40.9% vs 14.0%, p<0.001) owing to non-reassuring fetal heart rate (p=0.016) and failure of labour progress (p<0.001), a higher rate of postpartum haemorrhage (p<0.001), a longer duration of hospitalisation (p<0.001), and a higher rate of composite adverse maternal morbidity (67.7% vs 39.0%, p<0.001).

More neonates of febrile women were febrile at birth (21.3% vs 0%, p<0.001) and had a higher rate of neonatal complications including transient tachypnoea (7.3% vs 1.8%, p<0.017), clinical sepsis (17.7% vs 5.5%, p=0.001), longer length of hospitalisation (median, 5 vs 2 days, p<0.001), and a higher rate of composite adverse neonatal outcomes (24.4% vs 11.6%, p<0.003) [Table 2].

Significant risk factors found on univariate analysis were entered into multivariate logistic regression analysis. Predictors for intrapartum fever were hypertensive disease (adjusted odds ratio [aOR]=7.42, p=0.015), epidural analgesia (aOR=6.22, p<0.001), and duration of ruptured membranes (aOR=1.07, p=0.044) [Table 3]. Epidural analgesia was a predictor for composite adverse maternal outcome (aOR=2.65, p=0.007), whereas maternal

Table 1. Demographic, obstetric, and labour characteristics of patients with intrapartum fever and controls

Characteristic	Intrapartum fever cases (n=164)*	Controls (n=164)*	p Value
Maternal age, y	30.73±5.02	29.30±4.72	0.008
Advanced maternal age (≥35 y)	36 (22.0)	20 (12.2)	0.019
Body mass index, kg/m^2	22.39 (4.64)	21.53 (4.94)	0.083
Obesity (body mass index ≥25 kg/m^2)	36 (22.0)	35 (21.3)	0.893
Race			0.185
Chinese	150 (91.5)	156 (95.1)	
South Asian	14 (8.5)	8 (4.9)	
Smoker	21 (12.8)	24 (14.6)	0.630
Nulliparity	145 (88.4)	145 (88.4)	>0.99
Gestational age at delivery, wk	39 (2)	39 (2)	>0.99
Hypertensive disorders of pregnancy	22 (13.4)	2 (1.2)	<0.001
Diabetes in pregnancy	27 (16.5)	19 (11.6)	0.203
Group B *Streptococcus* carrier	35 (21.3)	45 (27.4)	0.199
Epidural analgesia	96 (58.5)	18 (11.0)	<0.001
Prelabour rupture of membranes	46 (28.0)	35 (21.3)	0.159
Induction of labour	126 (76.8)	75 (45.7)	<0.001
Meconium-stained amniotic fluid	22 (13.4)	19 (11.6)	0.616
Internal fetal monitoring	5 (3.0)	5 (3.0)	>0.99
Duration of rupture of membranes, h	12 (6)	6 (9)	<0.001
Total labour duration, h	8 (5)	5 (5)	<0.001
Intrapartum antibiotic use	158 (96.3)	36 (22.0)	<0.001
Mode of delivery			
Vaginal delivery	51 (31.1)	97 (59.1)	<0.001
Instrumental vaginal delivery	46 (28.0)	44 (26.8)	0.805
Caesarean delivery	67 (40.9)	23 (14.0)	<0.001
Caesarean section for non-reassuring fetal heart rate	26 (15.9)	12 (7.3)	0.016
Caesarean section for failure to progress	35 (21.3)	8 (4.9)	<0.001
Postpartum haemorrhage (blood loss ≥500 ml)	39 (23.8)	9 (5.5)	<0.001
Blood transfusion	1 (0.6)	1 (0.6)	>0.99
Intensive care unit admission	2 (1.2)	0	0.498
Hospitalisation, d	4±2	3±2	<0.001
Hospital readmission within 6 weeks of delivery	6 (3.7)	6 (3.7)	>0.99
Composite adverse maternal outcome	111 (67.7)	64 (39.0)	<0.001

* Data are presented as mean ± standard deviation, medium (range), or No. (%) of participants

temperature of ≥39°C was a predictor for composite adverse neonatal outcome (aOR=5.15, p=0.036) [Table 4]. Positive bacterial culture was not associated with poor neonatal outcomes. Higher degrees of maternal temperature were associated with higher composite maternal and neonatal morbidity (Table 5).

89 (54.3%) of febrile patients had positive culture results (either maternal/placenta or neonatal swabs), and 33 (20.1%) of febrile patients had more than one type of bacteria yielded. Although clinical chorioamnionitis was present in only 16 (9.8%) patients, histological chorioamnionitis was present in 121 (73.8%) patients. Gram-positive bacteria

Table 2. Neonatal outcomes of patients with intrapartum fever and controls

	Intrapartum fever cases (n=164)*	Controls (n=164)*	p Value
Male sex	84 (51.2)	81 (49.4)	0.740
Birthweight, g	3210.8±401.1	3155.9±368.6	0.197
Neonatal fever at birth (≥38°C)	35 (21.3)	0	<0.001
Apgar score <4 at 1 min	2 (1.2)	0	0.498
Apgar score <7 at 5 min	2 (1.2)	0	0.498
Umbilical cord blood pH <7.1	4/83 (4.8)	3/70 (4.3)	0.875
Resuscitation at birth	1 (0.6)	1 (0.6)	>0.99
Neonatal intensive care unit admission	9 (5.5)	4 (2.4)	0.157
Mechanical ventilation	8 (4.9)	5 (3.0)	0.396
Meconium aspiration	1 (0.6)	1 (0.6)	>0.99
Transient tachypnoea of newborn	12 (7.3)	3 (1.8)	0.017
Respiratory distress syndrome	1 (0.6)	2 (1.2)	>0.99
Haemodynamic instability	1 (0.6)	0	>0.99
Clinical sepsis	29 (17.7)	9 (5.5)	0.001
Pneumonia	2 (1.2)	2 (1.2)	>0.99
Meningitis	1 (0.6)	0	>0.99
Necrotising enterocolitis	1 (0.6)	0	>0.99
Hospitalisation, d	5 (2)	2 (2)	<0.001
Composite adverse neonatal outcome	40 (24.4)	19 (11.6)	0.003

* Data are presented as mean ± standard deviation, medium (interquartile range), or No. (%) of participants

Table 3. Multivariate logistic regression analysis for predictors of intrapartum fever

	Adjusted odds ratio (95% confidence interval)	p Value
Hypertensive disease	7.42 (1.48-37.10)	0.015
Epidural analgesia	6.22 (3.26-11.87)	<0.001
Advanced maternal age (≥35 y)	1.78 (0.87-3.61)	0.112
Induction of labour	1.27 (0.64-2.50)	0.491
Duration of ruptured membranes, h	1.07 (1.00-1.15)	0.044
Total labour duration, h	1.00 (0.99-1.00)	0.293

were found in 31.7% (n=52) of febrile patients. The most common was *Enterococcus* (48.1%), followed by Group B *Streptococcus* (15.4%), other *Streptococcus* (15.4%), *Staphylococcus* (15.4%), and *Diphtheroids* (5.8%). Gram-negative bacteria were found in 42.1% of febrile patients. The most common was *Escherichia coli* (65.2%), followed by extended-spectrum β-lactamases *E coli* (11.6%), *Proteus* (7.2%), *Bacteroides* (5.8%), *Prevotella* (4.3%), *Klebsiella* (2.9%), *Citrobacter* (1.4%), and *Morganella* (1.4%). Anaerobes (*Bifidobacterium*, *Peptoniphilus harei*, and *Ruminococcus*) were found in 3.0% of febrile patients. For Group B *Streptococcus*, all samples were sensitive to penicillin, but five of eight samples were resistant to clindamycin. Two samples of *Enterococcus* isolates were resistant to clindamycin or erythromycin. For *E coli* isolates, 2.2% were resistant to Augmentin, 15.6% were resistant to gentamicin, and 31.1% were resistant to trimethoprim/sulfamethoxazole, whereas 17.8% were sensitive to oral cefuroxime and all were sensitive to intravenous cefuroxime [Table 6].

Table 4. Multivariate logistic regression analysis for predictors of composite adverse maternal and neonatal outcomes

	Adjusted odds ratio (95% confidence interval)	p Value
Composite adverse maternal outcome		
Advanced maternal age (≥35 y)	1.52 (0.63-3.65)	0.348
Group B *Streptococcus* carrier	2.09 (0.82-5.34)	0.124
Parity	1.09 (0.62-1.90)	0.772
Epidural analgesia	2.65 (1.31-5.34)	0.007
Prolonged rupture of membranes (>18 h)	1.69 (0.44-6.52)	0.447
Maximal maternal temperature ≥39°C	1.14 (0.26-4.92)	0.862
Duration of intrapartum fever >4 h	1.44 (0.48-4.36)	0.517
Composite adverse neonatal outcome		
Advanced maternal age (≥35 y)	0.66 (0.25-1.77)	0.411
Group B *Streptococcus* carrier	0.57 (0.19-1.71)	0.316
Parity	0.31 (0.08-1.22)	0.093
Gestation at delivery	1.46 (1.00-2.14)	0.050
Epidural analgesia	1.60 (0.71-3.61)	0.261
Prolonged rupture of membranes (>18 h)	0.23 (0.03-1.92)	0.174
Maximal maternal temperature ≥39°C	5.15 (1.11-23.86)	0.036
Duration of intrapartum fever >4 h	0.39 (0.10-1.57)	0.183
Positive bacterial culture	1.32 (0.59-3.00)	0.501

Table 5. Higher maternal intrapartum temperature is associated with higher maternal and neonatal morbidity

Maternal intrapartum temperature, °C	Neonatal morbidity, %	Maternal morbidity, %
<38	11.6	39
38-39	22.1	68
>39	60	70

Discussion

To the best of our knowledge, this is the first study in Hong Kong evaluating the effects of intrapartum fever on both maternal and neonatal outcomes as well as the prevalence of microorganisms in patients with intrapartum fever and their rates of antibiotic resistance. These findings may guide future management of intrapartum fever.

The incidence of intrapartum fever in our hospital was 4.4%, which is within the range reported in the literature (1.6% to 14.6%)[1]. Predictors for intrapartum fever were hypertensive disease, epidural analgesia, and duration of ruptured membranes. Hypertensive disease is associated with intrapartum fever[9]. Pre-eclampsia is associated with a more vigorous systemic inflammatory response. Patients with pre-eclampsia have more remarkable systemic inflammatory response including leukocytic inflammatory markers and activity as well as inflammatory changes in endothelial or clotting function. This in turn triggers acute phase response such as fever[10].

Epidural anaesthesia is associated with intrapartum fever[4,11-13]. The rate of epidural analgesia-associated fever is approximately 20%[14]. In our cohort, almost 60% of patients with intrapartum fever received epidural analgesia. The underlying mechanism may be due to the change in the thermoregulation system[15], a decrease in heat-dissipating hyperventilation secondary to adequate pain relief[16] or possible inflammation state[17,18]. Compared with opioids, epidural analgesia is safe and effective to reduce labour pain[19] but is highly associated with intrapartum fever, which causes potential maternal and neonatal morbidity. In patients with both intrapartum fever and epidural analgesia, it is difficult to differentiate chorioamnionitis from non-infectious epidural analgesia–related fever. Hence, identifying predictors for poor maternal and neonatal outcomes is important.

Table 6. Gram-positive and -negative bacteria and their resistance to antibiotics*

	Penicillin	Erythromycin	Clindamycin	Augmentin	Cefuroxime (oral)	Cefuroxime (intravenous)	Gentamicin	Levofloxacin	Trimethoprim/ sulfamethoxazole
Gram-positive bacteria									
Group B *Streptococcus*	0/8	1/8 (12.5)	5/8 (62.5)	-	-	-	-	-	-
Other *Streptococcus*	0/8	0/8	1/8 (12.5)	-	-	-	-	-	-
Enterococcus	0/25	1/25 (4.0)	1/25 (4.0)	-	-	-	-	-	-
Staphyloccocus	2/8 (25.0)	1/8 (12.5)	-	-	-	-	-	-	-
Gram-negative bacteria									
Escherichia coli	-	-	-	1/45 (2.2)	8/45 (17.8)†	0/45	7/45 (15.6)	6/45 (13.3)	14/45 (31.1)
Extended-spectrum β-lactamases *E coli*	-	-	-	0/8	-	-	2/8 (25.0)	1/8 (12.5)	5/8 (62.5)
Bacteroides	-	-	-	0/4	0/4	0/4	0/4	0/4	1/4 (25.0)
Proteus	-	-	-	0/5	0/5	0/5	0/5	0/5	0/5
Klebsiella	-	-	-	0/2	0/2	0/2	0/2	0/2	0/2

* Data are presented as No. (%) of samples resistance to antibiotics
† Intermediate sensitivity to cefuroxime (oral)

Longer duration of ruptured membranes was associated with intrapartum fever. Prolonged ruptured membranes exacerbate the exposure of the uterine cavity or fetus to potential microbial threats[20]. In our practice, prophylactic antibiotics and septic workup are provided for parturients who have fever or prolonged ruptured membranes for >18 hours. For those with prelabour rupture of membranes, induction of labour is performed to shorten the duration of ruptured membranes and the first stage of labour. This practice is supported by a meta-analysis of 23 randomised trials of patients with prelabour rupture of membranes at ≥37 weeks of gestation[21]. Reduction in the time from membrane rupture to birth lowers the rates of chorioamnionitis/endometritis and admission to neonatal special care or intensive care unit. In a study analysing data from the TERMPROM trial, compared with expectant management, labour induction within the first 20 hours following prelabour rupture of membranes is associated with a reduction in the risk of the composite adverse neonatal outcome, whereas labour induction within the first 15 hours following prelabour rupture of membranes results in reduction in the rates of neonatal intensive care unit admission and maternal infectious morbidity[22]. Although early induction of labour may not prevent intrapartum fever, it acts as a precautionary way to reduce the duration labour and the occurrence of neonatal sepsis.

Epidural analgesia was a predictor for composite adverse maternal outcomes, whereas extremely high maternal temperature was a predictor for composite adverse neonatal outcomes. Epidural analgesia is associated with increased rates of instrumental delivery and caesarean section[23-25]. Increased rates of operative delivery in turn increase the risks of postpartum haemorrhage, blood transfusion, wound complications, hospital stay, and readmission secondary to complications. Therefore, it is important for obstetricians and anaesthetists to explain the risks and benefits of epidural anaesthesia and its associations with intrapartum fever and delivery modes.

Maternal intrapartum fever is associated with neonatal complications in a dose-dependent manner[7]. Extremely elevated intrapartum fever is an important indicator of severe neonatal morbidity, with increased rates of neonatal sepsis, low Apgar scores, and neonatal intensive care unit admission as well as higher risk of operative delivery[6]. In our study, higher maternal temperature was associated with poorer composite adverse neonatal outcomes. Although a high temperature of >39°C during labour is uncommon, it can cause adverse fetal outcomes. The mechanism of high temperature causing perinatal morbidities includes the inflammatory process, the lower threshold for hypoxic brain injury, and the higher fetal rate of metabolic expenditure[7]. To minimise the adverse impact of intrapartum fever, obstetricians should administer antipyretics in time, monitor the labour progress regularly, avoid prolonged labour, ensure adequate hydration, avoid unnecessary vaginal examinations and high environmental

temperature, avoid prolonged high body temperature, and alert paediatricians early to optimise neonatal evaluation and management.

In our study, intrapartum fever (≥38°C) was associated with increased maternal morbidity. Those with high temperature (≥39°C) did not significantly differ from those with moderately high temperature (38°C-38.9°C) in terms of composite adverse maternal outcomes. This may be due to the small sample size of the high fever group (4.9%).

Positive bacterial culture is associated with poor neonatal outcomes[8]. However, in our study, positive bacterial culture was not associated with poor composite adverse neonatal outcomes. This may be due to the small sample size, environmental contamination of some cultures (especially ear swab), and intrapartum antibiotic use (to inhibit bacterial growth).

All parturients with intrapartum fever received empirical antibiotics once fever was confirmed. The World Health Organization guideline recommends a simple regimen such as ampicillin and once-daily gentamicin as the first-line antibiotics for chorioamnionitis[26]. The American College of Obstetricians and Gynecologists guideline recommends that antibiotics should be considered in patients with isolated maternal fever unless causes other than intraamniotic infection are identified, and that the drug of choice should be a combination of ampicillin and gentamicin[2]. In Hong Kong, antibiotic regimens for intrapartum fever vary among hospitals. Some hospitals administer single antibiotics (benzyl-penicillin, ampicillin, Augmentin), whereas others use a combination of antibiotics (ampicillin plus metronidazole, ampicillin plus gentamicin, and Augmentin plus gentamicin). No one antibiotic is superior to another[27,28].

In our cohort, surprisingly, the most common gram-positive bacteria in both maternal and neonatal cultures were *Enterococcus faecalis* rather than Group B *Streptococcus*. *E coli* was the most common gram-negative bacteria. Similarly, in another study, the most common organisms cultured in fever patients were *E coli* (17%), Group B *Streptococcus* (4.4%), and *Enterococcus faecalis* (3.4%)[29]. In our cohort, the rate of resistance to gram-positive bacteria to penicillin was low. Therefore, the use of penicillin group antibiotics in febrile patients is justified. In our hospital, ampicillin was used empirically for intrapartum fever. Owing to the high prevalence of *E coli* and its likely resistance to ampicillin (resistance rate of 76% in the Hong Kong guideline IMPACT[30]), changing the antibiotics to Augmentin or intravenous cefuroxime is sensible. Broad-spectrum antibiotics should be used as chorioamnionitis is usually polymicrobial. Augmentin is easily available and possesses β-lactamase-inhibiting properties and covers a wide range of β-lactamase-producing pathogens. However, Augmentin is not recommended for patients with preterm/premature rupture of membranes because of its association with neonatal necrotising enterocolitis[31,32]. Gentamicin is widely used as the antibiotic of choice for intrapartum chorioamnionitis[33], but *E coli* has a relatively high rate of resistance to gentamicin (30% of *E coli* are resistant to gentamicin according to the IMPACT guideline[30] and 15.6% of *E coli* are resistant to gentamicin based on our data). It may not be appropriate to add gentamicin in the empirical antibiotic regimen in Hong Kong. In addition, there is no ground to add metronidazole owing to low culture rates of anaerobes. Future studies to compare Augmentin, intravenous cefuroxime with ampicillin, and a combination of antibiotics in managing chorioamnionitis are warranted.

Limitations to this study include the retrospective design and small sample size. In addition, our hospital's microbiology laboratory did not perform sensitivity testing of Gram-negative bacteria to ampicillin. This hindered our estimation of effectiveness of ampicillin to treatment of intrapartum fever.

Conclusion

Intrapartum fever is associated with poor maternal and neonatal outcomes. Obstetricians should avoid long duration of labour and high maternal temperature. The choice of antibiotics for intrapartum fever/chorioamnionitis should be carefully selected, with consideration of efficacy, possible adverse effects, and antimicrobial resistance.

Contributors

All authors designed the study, acquired the data, analysed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Data availability

All data generated or analysed during the present study are available from the corresponding author on reasonable request.

Ethics approval

This study was approved by the New Territories West Research Ethics Committee (reference: NTWC/REC/22044). The patients were treated in accordance with the tenets of the Declaration of Helsinki. The patients provided written informed consent for all treatments and procedures and for publication.

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