Open Journal of Obstetrics and Gynecology, 2011, 1, 42-46 **OJOG**
doi:10.4236/ojog.2011.12009 Published Online June 2011 (http://www.SciRP.org/journal/ojog/).

Perinatal outcomes associated with meconium-stained amniotic fluid in Japanese singleton pregnancies

Misao Satomi, Yoshie Hiraizumi, Shunji Suzuki

Department of Obstetrics and Gynecology, Japanese Red Cross Katsushika Maternity Hospital, Tokyo, Japan.
Email: czg83542@mopera.ne.jp

Received 3 May 2011; revised 31 May 2011; accepted 9 June 2011.

ABSTRACT

Introduction: We examined the perinatal outcomes in Japanese singleton pregnancies associated with meconium-stained amniotic fluid (MSAF) in relation to gestational age at delivery. Methods: We reviewed the obstetric records of all Japanese singleton deliveries after 22 weeks' gestation managed at Japanese Red Cross Katsushika Maternity Hospital between 2002 and 2008 (n = 11,249). Results: The incidence of MSAF in the whole singleton pregnancies was 13%. The incidence of MSAF at preterm, term and postterm were 9.1%, 13% and 48%, respectively. The incidence of intrauterine fetal death, low Apgar score and low umbilical artery pH at delivery in cases with MSAF were significantly higher than those without MSAF in various gestational ages at delivery. Conclusion: Obstetric management should be affected by meconium in the amniotic fluid.

Keywords: Meconium-Stained Amniotic Fluid; Perinatal Outcome; Preterm; Term; Postterm

1. INTRODUCTION

Meconium-stained amniotic fluid (MSAF) has been reported to be associated with an obstetric hazard and significantly increase risks of adverse neonatal outcomes at term and preterm [1-7]. Although overall risk of adverse outcome in MSAF has been reported to be low [2], MSAF is suggested to signify underlying acute or chronic fetal hypoxia [1-7]. Recently, MSAF rates have been reported to be different among races and across gestational age [2]. For example, Balchin *et al.* [2] observed that the incidence of MSAF in South Asian is higher than that in whites (Crude odds ratio 3.31, 95% confidence interval 1.3 - 8.3, $p < 0.01$ by x^2 test); however there have not been well documented in MSAF in Japanese populations. In this study, we examined the perinatal outcomes in Japanese singleton pregnancies associated with MSAF in relation to gestational age at delivery.

2. METHODS

The protocol for this study was approved by the Ethics Committee of the Japanese Red Cross Katsushika Maternity Hospital. In addition, informed consent concerning analysis from a retrospective database was obtained from each subject.

We reviewed the obstetric records of all Japanese singleton deliveries after 22 weeks' gestation managed at Japanese Red Cross Katsushika Maternity Hospital between 2002 and 2008 (n = 11,249). The gestational age of the pregnancies were established by ultrasonographic examination of the fetal crown-rump length at 9-11 weeks' gestation. In all cases of intrauterine fetal death (IUFD), survival was checked within 2 weeks before the period of the IUFD diagnosis. The presence of MSAF was diagnosed clinically during delivery. The characteristics of perinatal outcomes such as IUFD, neonatal Apgar score at 1 and 5 minutes and umbilical artery pH were extracted from patient charts. In this study, the subjects were divided into 5 groups by gestational age at delivery as follows: those delivered at 22 - 28, 29 - 32, 33 - 36, 37 - 40 and 41 - 43 weeks' gestation.

Cases and controls were compared by x^2 test for categorical variables. Odds ratios (ORs) and 95% confidence intervals (CIs) were also calculated. Differences with $P < 0.05$ were considered significant.

3. RESULTS

Table 1 shows the incidence of MSAF in the Japanese singleton pregnancies by gestational age at delivery. The incidence of MSAF in the whole singleton pregnancies was 13% (1,409/11,249). The incidence of MSAF at preterm (22 - 36 weeks), term (37 - 41 weeks) and postterm (42 - 43 weeks) were 9.1% (73/804, $p < 0.01$ vs. term, OR 0.70, 95% CI 0.54 - 0.89), 13% (1,297/10,363) and 48% (39/82, $p < 0.01$ vs. term, OR 6.34, 95% CI 4.1 - 9.8), respectively.

Table 2 shows the incidence of MSAF in the 5 periods of deliveries in the Japanese singleton pregnancies. As shown in **Table 2**, the incidence of MSAF at 33 - 36 weeks was significantly lower than that at 37 - 40 weeks ($p < 0.01$), however the incidence of MSAF at 22 - 31 weeks was not different significantly from that at 37-40 weeks ($p = 0.24$). The incidence of MSAF at 41 - 43 weeks was significantly higher than that at 37 - 40 weeks ($p < 0.01$). Therefore, there was a 'J-shaped' relationship between MSAF and advancing gestational age, with a nadir at 33 - 36 weeks' gestation.

Table 3 shows the perinatal outcomes in the 5 periods of deliveries in the Japanese singleton pregnancies. In total, the incidence of IUFD, low Apgar score and low umbilical artery pH at delivery in cases with MSAF were significantly higher than those without MSAF ($p < 0.01$). The incidence of IUFD in cases with MSAF was significantly higher than that without MSAF at 29 - 32 ($p = 0.03$) and 33 - 36 weeks' gestation ($p < 0.01$). The incidence of neonatal low Apgar score at 1 minute in cases with MSAF was significantly higher than that without MSAF at 33 - 36 ($p < 0.01$), 37 - 0 ($p < 0.01$) and 41 - 43 weeks' gestation ($p < 0.01$). The incidence of neonatal low Apgar score at 5 minute in cases with MSAF was significantly higher than that without MSAF at 22 - 28 ($p = 0.02$), 33 - 36 ($p < 0.01$), 37 - 40 ($p < 0.01$) and 41 - 43 weeks' gestation ($p < 0.01$). In addition, the incidence of low umbilical artery pH in cases with MSAF was significantly higher than that without MSAF at 22 - 28 ($p = 0.02$), 33 - 36 ($p < 0.01$), 37 - 40 ($p = 0.03$) and 41 - 43 weeks' gestation ($p < 0.01$).

Table 1. The incidence of msaf in the japanese singleton pregnancies by gestational age at delivery.

Gestational age at delivery (weeks)	Number of delivery	Meconium-stained amniotic fluid
22	7	2 (29%)
23	5	1 (20%)
24	7	1 (14%)
25	13	4 (31%)
26	11	1 (9.1%)
27	22	4 (18%)
28	25	1 (4.0%)
29	47	3 (6.4%)
30	46	6 (13%)
31	49	6 (12%)
32	87	10 (11%)
33	98	8 (8.2%)
34	155	9 (5.8%)
35	143	8 (5.6%)
36	289	9 (3.1%)
37	943	31 (3.3%)
38	1,873	127 (6.8%)
39	2,902	327 (11%)
40	2,877	484 (17%)
41	1,568	328 (21%)
42	78	37 (47%)
43	4	2 (50%)
Total	11,249	1,409 (13%)

Values are expressed as number (%). *P* values by X^2 test.

Table 2. The incidence of MSAF in the 5 periods of delivery in the Japanese singleton pregnancies.

Gestational age at delivery	Number of delivery	Meconium-stained amniotic fluid	P-value	Crude OR	95% CI
22 - 28 weeks	90	14 (16%)	0.2	1.45	0.82 - 2.6
29 - 32 weeks	229	25 (11%)	0.87	0.96	0.63 - 1.5
33 - 36 weeks	685	34 (5.2%)	<0.01	0.41	0.29 - 0.58
37 - 40 weeks*	8,595	969 (11%)	-	1	
41 - 43 weeks	1,650	367 (22%)	<0.01	2.25	2.0 - 1.6
Total	11,249	1,409 (13%)			

*Reference group. Values are expressed as number (%). P values by X2 test. OR, odds ratio; 95% CI, 95% confidence interval; IUFD, intrauterine fetal death.

Table 3. The perinatal outcomes in the 5 periods of delivery in the Japanese singleton pregnancies.

Gestational age at delivery		Meconium-stained amniotic fluid		P-value	Crude OR	95% CI
		(-)	(+)			
22 - 28 weeks	Total	90	14			
	IUFD	23 (26%)	5 (36%)	0.67	-	
	Live fetuses	67	9			
	Apgar score (1 min)					
	<4	13 (19%)	4 (44%)	0.09	-	
	<7	18 (27%)	4 (44%)	0.27	-	
	Apgar score (5 min)					
	<4	5 (7.5%)	3 (33%)	0.02	6.2	1.2 - 33
	<7	13 (19%)	3 (33%)	0.34	-	
	UApH < 7.0	2 (3.0%)	2 (22%)	0.02	9.29	1.1 - 77
29 - 32 weeks	Total	229	25			
	IUFD	7 (3.1%)	3 (12%)	0.03	4.32	1.0 - 17
	Live fetuses	222	22			
	Apgar score (1 min)					
	<4	8 (3.6%)	2 (9.1%)	0.22	-	
	<7	40 (18%)	5 (23%)	0.59	-	
	Apgar score (5 min)					
	<4	3 (1.4%)	1 (4.5%)	0.26	-	
	<7	13 (5.9%)	2 (9.1%)	0.55	-	
	UApH < 7.0	2 (0.90%)	0 (0%)	0.65	-	
33 - 36 weeks	Total	685	34			
	IUFD	4 (0.58%)	2 (5.9%)	<0.01	10.6	1.9 - 60
	Live fetuses	681	32			
	Apgar score (1 min)					
	<4	16 (2.3%)	6 (19%)	<0.01	9.59	3.5 - 27
	<7	39 (5.7%)	6 (19%)	<0.01	3.8	1.5 - 9.8
	Apgar score (5 min)					
	<4	4 (0.58%)	1 (3.1%)	0.09	-	
	<7	15 (2.2%)	4 (13%)	<0.01	6.34	2.0 - 20
	UApH < 7.0	5 (0.73%)	2 (6.3%)	<0.01	9.01	1.7 - 48
37 - 40 weeks	Total	8,595	969			
	IUFD	7 (0.081%)	3 (0.31%)	0.04	3.81	1.0 - 15
	Live fetuses	8,588	966			

	Apgar score (1 min)					
	<4	25 (0.29%)	7 (0.72%)	0.03	2.5	1.1 - 5.8
	<7	68 (0.79%)	27 (2.8%)	<0.01	3.6	2.3 - 5.6
	Apgar score (5 min)					
	<4	6 (0.070%)	5 (0.52%)	<0.01	7.44	2.3 - 24
	<7	18 (0.21%)	6 (0.62%)	0.02	2.98	1.2 - 7.5
	UApH < 7.0	11 (0.13%)	4 (0.41%)	0.03	3.24	1.0 - 10
41 - 43 weeks	Total	1,650	367			
	IUFD	1 (0.061%)	1 (0.27%)	0.24	-	
	Live fetuses	1,649	366			
	Apgar score (1 min)					
	<4	3 (0.18%)	10 (2.7%)	<0.01	15.4	4.2 - 56
	<7	16 (0.97%)	22 (6.0%)	<0.01	6.53	3.4 - 13
	Apgar score (5 min)					
	<4	2 (0.12%)	1 (0.27%)	0.49	-	
	<7	3 (0.18%)	5 (1.4%)	<0.01	7.6	1.8 - 32
	UApH < 7.0	11 (0.67%)	8 (2.2%)	<0.01	3.3	1.3 - 8.3
Total (22 - 43 weeks)	Total	11,249	1,409			
	IUFD	42 (0.52%)	14 (0.99%)	<0.01	2.68	1.5 - 4.9
	Live fetuses	11,207	1,395			
	Apgar score (1 min)					
	<4	65 (0.58%)	29 (2.1%)	<0.01	3.62	2.3 - 5.6
	<7	181 (1.6%)	64 (4.5%)	<0.01	2.91	2.2 - 3.9
	Apgar score (5 min)					
	<4	20 (0.18%)	11 (0.78%)	<0.01	4.42	2.1 - 9.2
	<7	62 (0.55%)	20 (1.4%)	<0.01	2.6	1.6 - 4.3
	UApH < 7.0	31 (0.28%)	16 (1.1%)	<0.01	4.16	2.3 - 7.6

Values are expressed as number (%). P values by X^2 test. OR, odds ratio; 95% CI, 95% confidence interval; IUFD, intrauterine fetal death.

4. DISCUSSION

The relationship between the presence of MSAF and increased odds for birth asphyxia and neonatal mortality is well established in preterm, term and postterm infants [1-7]. We also found that in the infants with MSAF, the prevalence of IUFD and/or neonatal asphyxia (low Apgar scores and/or low umbilical artery pH) was increased compared with those without MSAF in Japanese singleton pregnancies in various gestational age at delivery. Therefore, obstetric management should be affected by meconium in the amniotic fluid in all periods of pregnancy beyond 22 weeks' gestation.

In this study, there was a "J-shaped" relationship between MSAF and advancing gestational age, with a nadir at late-preterm (33 - 36 weeks' gestation); because MSAF has been suggested to be mainly associated with fetal gastrointestinal maturity rather than hypoxia under hormonal and neural control [1,2,6]. This 'J-shaped' tendency seems to be similar to some previous studies [2,6]; however the period of nadir in this study seems to be later than those in these previous studies. For example, the incidence of preterm MSAF at <33 weeks observed by Tybulewicz *et al.* [6] and Balchin *et al.* [2] were only 4.3% and 5.3%, respectively; however it was 12% in the current study. The small sample size and/or the racial differences may be possible reasons leading to the differences. One of other possible reasons may be that the current data included the cases of IUFD. In this study, for example, the incidence of MSAF in live births at <33 weeks was 9.7%. Some serious perinatal complications such as cerebral palsy and/or severe intraventricular hemorrhage have been reported to be more common in infants with preterm MSAF [5,6]. Therefore, it may be reasonable that the incidence of MSAF increased in this study including IUFD as serious complication, because over half of IUFD has been reported to occur during the premature period [8]. Otherwise, very premature delivery itself can be indicated as "serious complication" equivalent to IUFD. Therefore, further prospective examination may be needed to clarify the relation between

MSAF and perinatal outcomes at very preterm.

At 41 - 43 weeks' gestation, on the other hand, the incidence of low Apgar score and low umbilical artery pH in cases with MSAF were also significantly higher than those without MSAF. Postterm gestation itself has been suggested to be associated with the increased risk of perinatal mortality [9]. The higher rate of perinatal morbidity at postterm gestation may be due to hypoxia/acidemia associated with "relative placental insufficiency" where the placenta can no longer keep up the demands of the fetus [10]. These conditions may be also associated with the presence of MSAF. In addition, when MSAF is superimposed on fetal acidemia, there is an increased risk of meconium aspiration syndrome [4]. Therefore, the greater risk of adverse neonatal outcomes at ≥41 weeks in the current study support these previous suggestions especially in cases with MSAF [4,10].

In conclusion, obstetric management should be affected by meconium in the amniotic fluid in various gestational ages at delivery. Therefore, management requires awareness of this potential risk, appropriate intrapartum care and a combined obstetric-neonatal approach in cases with MSAF.

REFERENCES

[1] Ash, A.K. (2000) Managing patients with meconium-stained amniotic fluid. *Hospital Medicine*, **61**, 844-848.

[2] Balchin, I., Whittaker, J.C., Lamont, R.F. and Steer, P.J. (2011) Maternal and fetal characteristics associated with meconium-stained amniotic fluid. *Obstetrics & Gynecology*, **117**, 828-835. doi:10.1097/AOG.0b013e3182117a26

[3] Natah, L., Leveno, K.J., Carmody III, T.J., Kelly, M.A. and Sherman, M.L. (1994) Meconium: A 1990s perspective on an old obstetric hazard. *Obstetrics & Gynecology*, **83**, 329-332.

[4] Ramin, K.D., Leveno, K.J., Kelly, M.A. and Carmody, T.J. (1996) Amniotic fluid meconium: A fetal environmental hazard. *Obstetrics & Gynecology*, **87**, 181-184. doi:10.1016/0029-7844(95)00403-3

[5] Spinillo, A., Fazzi, E., Capuzzo, E., Stronati, M., Piazzi, G. and Ferrari, A. (1997) Meconium-stained amniotic fluid and risk for cerebral palsy in preterm infants. *Obstetrics & Gynecology*, **90**, 519-523. doi:10.1016/S0029-7844(97)00308-6

[6] Tybulewicz, A.T., Clegg, S.K., Fonfe, G.J. and Stenson, B.J. (2004) Preterm meconium staining of the amniotic fluid: associated findings and risk of adverse clinical outcome. *Archives of Disease in Childhood—Fetal & Neonatal Edition*, **89**, F328-F330. doi:10.1136/adc.2002.021949

[7] Ziadeh, S.M. and Sunna, E. (2000) Obstetric and perinatal outcome of pregnancies with term labour and meconium-stained amniotic fluid. *Archives of Gynecology and Obstetrics*, **264**, 84-87. doi:10.1007/s004040000088

[8] Gardosi, J., Mul, T., Mongelli, M. and Fagan, D. (1998) Analysis of birthweight and gestational age in antepartum stillbirths. *British Journal of Obstetrics and Gynecology*, **105**, 524-530. doi:10.1111/j.1471-0528.1998.tb10153.x

[9] Suzuki, S. (2009) Post-term pregnancy as a risk factor for intrapartum fetal distress. *Journal of Perinatal Medicine*, **37**, 420-421. doi:10.1515/JPM.2009.055

[10] Volherr, H. (1975) Placental insufficiency in relation to postterm pregnancy and fetal postmaturity: Evaluation of fetoplacental function; management of the postterm gravida. *American Journal of Obstetrics & Gynecology*, **123**, 67-103.

