MECONIUM STAINED AMNIOTIC FLUID IN TERM PREGNANCIES: A STUDY ON RISK FACTORS AND OUTCOMES

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Abstract

Background: It is estimated that 10-20% of term babies were born with meconium stained amniotic fluid (MSAF), and the rates of mortality and morbidity of this group were higher than those with clear fluid. This study aimed to estimate risk factors and to assess outcomes of term pregnancies with MSAF. **Materials & methods:** A cross-sectional descriptive study, implemented from April, 2011 to July, 2012 on 368 term pregnancies with MSAF and 373 others with clear fluid as controls group. Inclusion criteria were singleton pregnancies with gestational age (GA) from 38 weeks 0 day to 41 weeks 6 days, cephalic presentation. Exclusion criteria were pregnancies with malformation fetus, could not estimated the GA, and the women who had cardiotocography (CTG) shorter than 30 minutes. Odd-ratios (OR) were used to calculate the difference between the two groups in the rate of maternal age (MA) older than 30 years old, postdate pregnancies, PROM, labor in active phase, and the rate of abnormal CTG. The difference between the two groups in the rate of Cesarean section (C-section) was calculated by risk-ratio (RR). Logistic regression model was used to find out some models to predict the potential of acidosis in newborns from pregnancies with MSAF. **Results:** Maternal age greater than 30 and post date pregnant are risk factors of MSAF with odds-ratio are 4.02 (95% CI: 2.95 - 5.48) and 3.94 (95% CI: 2.84 - 5.48), respectively. PROM and labor in active phage are not risk factors of the disorder. The rate of abnormal CTG is 5.47 (95% CI: 3.57 - 8.38) when the rate of C-section is 2.1 (95%CI: 1.72 - 2.57) times higher than clear fluid group. The rate of acidemia is 7.1%, and 4.93 (95%CI: 1.83 - 10.54) times higher than controls. CTG type 3 is the sign in which we can predict the acidemia of these babies with 96.2% accuracy rate. But these with only 93.5% if there are type 2 CTG and thick-green meconium. **Conclusions:** In term pregnancies, maternal age older than 30 and postdate pregnancies are risk factors of MSAF. This group of pregnancies has higher rate of abnormal CTG, C-section, and acidemia babies.

Keywords: *Meconium stained amniotic fluid (MSAF), abnormal CTG, C-section, acidemia.*

1. INTRODUCTION

The meaning of meconium passage in amniotic fluid claimed to vary between its entirely being physiological to a sign of fetal distress as a response to hypoxic condition. If meconium stained amniotic fluid (MSAF) is found, continuous fetal heart rate monitoring is required for fetal well being. It is estimated that 10-20% of term babies were born with meconium stained amniotic fluid (MSAF), the rates of mortality and morbidity of this group were higher than babies with clear fluid.

There are many studies around the world on this problem, and many risk factors were determined to be correlated with this condition, but the main cause is still unknown. In Vietnam, investigations on the influence of MSAF on pregnancy outcomes are still very limited. Therefore, the aims of this study were to estimate some risk factors and to assess the outcomes of term pregnancies with meconium stained amniotic fluid (MSAF).

2. MATERIALS & METHODS

This was a case-control study implemented from April, 2011 to July, 2012 at the Department of Obsetrics and Gynecology, Hue Central Hospital. 368 term pregnancies with MSAF and 373 other

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*- Received: 10/11/2013 * Revised: 15/12/2013 * Accepted: 27/12/2013*

DOI: 10.34071/jmp.2013.2e.14

term pregnancies with clear fluid as control group were recruited.

Selection criteria:

- singleton pregnancies with gestational age (GA) from 38 weeks 0 day to 41 weeks 6 days,
- cephalic presentation.

Exclusion criteria:

- pregnancies with malformation fetus,
- GA could not be exactly estimated
- Cardiotocography (CTG) enregistered shorter than 30 minutes.

The women inlcuded in this study were asked about their age, number of pregnancies, the first day of last period of menstruation (to calculate her GA), and signs of labor. Then they were performed CTG, classify the records into three types using the classification of US National Institute of Child Health and Diseases.

At the delivery, the newborns were assessed by Apgar score at 1st and 5th minute, and blood from the cord was collected to evaluate pH level. These results were used for comparison between two groups.

The participants were analyzed by maternal age, gestational age, and premature rupture of membranes (PROM), the phase of labor, the rate of contractions, type of CTG, and the length of labor. And their newborns were analyzed by birth weight, pH of cord blood sample.

Odd-ratios (OR) were used to calculate the difference between the two groups in the rate of maternal age (MA) older than 30 years old, postdate pregnancies, PROM, labor in active phase, and the rate of abnormal CTG. The difference between the two groups in the rate of Cesarean section (C-section) was calculated by risk-ratio (RR). And at last, we used the logistic regression model to find out some models to predict the potential of acidosis in newborns from pregnancies with MSAF.

3. RESULTS

3.1. Colors of amniotic fluid

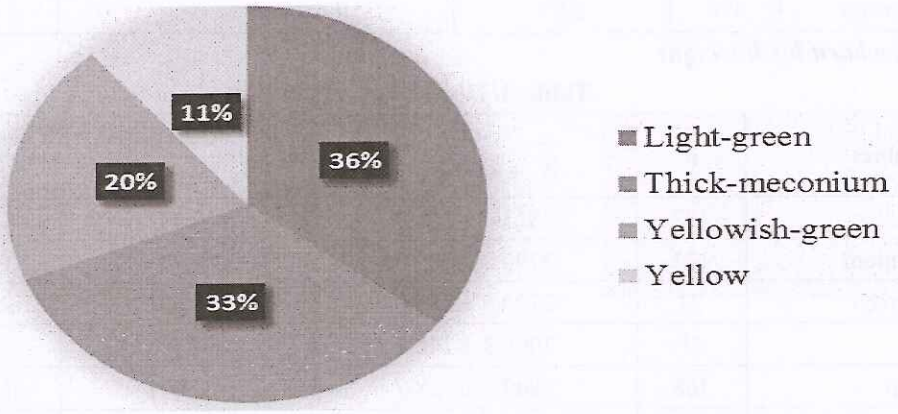

Fig. 1. Colors of amniotic fluid

3.2. MSAF risk factors

Table 1. Some risk factors of MSAF

Risk factors	Compared with clear fluid group		
	OR	95% CI	p
Maternal older than 30 years old	4.02	2.95 - 5.48	< 0.001
Postdate pregnant	3.94	2.84 - 5.48	< 0.001
PROM	1.17	0.86 - 1.59	0.33
Active phage of labor	1,08	0.80 - 1.48	0.61
	MASF	Clear fluid	p
Number of pregnancies	2.3 ± 1.1	2.4 ± 1.2	0.22
Contractions/10 minutes	3.2 ± 0.9	2.9 ± 0.9	< 0.001
Length of labor (hours)	10.2 ± 4.2	9.2 ± 4.7	0.001

3.3. Records of cardiotocography

Table 2. Records of cardiotocography

Colors	n	CTG		Compared with clear fluid	
		Normal (%)	Abnormal (%)	OR	95% CI
Light-green	132	81.1	18.9	2.58	1.46 - 4.56
Thick-meconium	122	41.0	59.0	15.87	9.48 - 26.56
Yellowish-green	73	74.0	26.0	3.89	2.05 - 7.37
Yellow	41	85.4	14.6	1.89	0.74 - 4.84
MSAF group	368	66.9	33.2	5.47	3.57 - 8.38
Clear fluid group	373	91.7	8.3		

3.4. Pregnancy outcomes

3.4.1. Route of delivery

Table 3. Rate of C-section

Colors	n	Route of delivery		Compared with clear fluid	
		C-section	Vaginal	RR	95% CI
Light-green	132	30.3	69.7	1.22	0.90 - 1.66
Thick-meconium	122	77.0	23.0	3.09	2.53 - 3.77
Yellowish-green	73	63.0	37.0	2.53	1.97 - 3.24
Yellow	41	31.7	68.3	1.27	0.78 - 2.06
MSAF group	368	52.4	47.6	2.10	1.72 - 2.57
Clear fluid group	373	24.9	75.1		

3.4.2. Newborn birth weight

Table 4. Newborn birth weight

Colors	n	$\overline{X}$ ± SD (gram)	Compared with clear fluid	
			p	95% CI
Light-green	132	2813.6 ± 395.7	< 0.001	175.9 - 319.1
Thick-meconium	122	2790.2 ± 399.7	< 0.001	197.1 - 344.8
Yellowish-green	73	2720.5 ± 386.9	< 0.001	251.7 - 429.5
Yellow	41	3009.8 ± 245.8	0.230	NS*
MSAF group	368	2809.2 ± 388.2	< 0.001	198.8 - 305.0
Clear fluid group	373	3061.1 ± 346.6		

*NS: Non significant

3.4.3. pH level of cord blood samples

Table 5. pH level of cord blood samples

Colors	n	Median	Min	Max	$\overline{X}$ ± SD	Compared with clear fluid
Light-green	132	7.23	6.95	7.35	7.21 ± 0.09	< 0.001
Thick-meconium	122	7.19	6.94	7.38	7.17 ± 0.09	< 0.001
Yellowish-green	73	7.26	6.93	7.35	7.22 ± 0.09	0.007
Yellow	41	7.27	6.99	7.36	7.25 ± 0.08	0.908
MSAF group	368	7.22	6.93	7.36	7.19 ± 0.09	< 0.001
Clear fluid group	373	7.26	7.12	7.38	7.25 ± 0.05	

Table 6. pH level of cord blood sample

Colors	n	pH level		Compared with clear fluid	
		Acidemia (%)	Normal (%)	RR	95% CI of RR
Light-green	132	3.8	96.2	2.35	0.73 - 7.57
Thick-meconium	122	11.5	88.5	7.13	2.80 - 18.15
Yellowish-green	114	6.1	93.9	3.82	1.31 - 11.14
Yellow	368	7.1	92.9	4.39	1.83 - 10.54
MSAF group	373	1.6	98.4		

Table 7. Some risk factors of acidemia in newborns with MSAF

Factors		Acidemia	Normal	General	Correlations
Postdate pregnancies	Yes	14	163	177	$\chi^2 = 1.077$ p = 0.299
	No	10	181	191	
PROM	Yes	18	238	256	$\chi^2 = 0.358$ p = 0.550
	No	6	106	112	
C-section	Yes	21	172	193	$\chi^2 = 12.650$ p < 0.001
	No	3	172	175	
Phage of labor	Active	6	186	192	$\chi^2 = 7.598$ p = 0.006
	Latent	18	158	176	
Birth weight	< 2500 g	10	93	103	$\chi^2 = 2.383$ p = 0.123
	≥ 2500 g	14	251	256	

3.5. Predicting models for acidemia status of newborns with MSAF

Table 8. Models that predict the acidemia status of newborns with MSAF

No.	Models	- 2LL*	Accuracy (%)	p
1	CTG type 3+MSAF	109.89	96.2	**0.029**
2	CTG type 2+ thick meconium	168.92	93.5	**0.046**
3	CTG type 2+ thick meconium +SGA**	167.06	93.5	**0.038**
4	CTG type 2+Light-green	NS***		0.097
5	CTG type 2+light-green+SGA	NS		0.078
6	CTG type 2+Yellowish-green	NS		0.077
7	CTG type 2+ Yellowish-green +SGA	NS		0.062

*-2LL: -2 log likelihood. **SGA: small for gestational age. ***NS: non-significant.

4. DISCUSSION

4.1. Rate of colors of amniotic fluid in MSAF pregnancies

According to figure 1, light-green is the most common colors in MSAF group, 35.9%, and thick-green is the second one, 33.2%.

In term pregnancies, the color of the amniotic fluid is mainly affected by secretions from the fetus. Many researchers in around the world demanded the problem but they classified the colors based on the level of meconium in amniotic fluid, include light, medium and thick meconium in the fluid [4], [12], or some of them used the classification of three levels, these are level I, II, and III [7], and others separate them into two groups, that are light and thick meconium [9].

A study in Turkey by Narli N. and colleagues with 278 participants, there were 20.6% with thick meconium in the fluid [8], when Naveen S. and his colleagues studied in Indian with 1009 pregnant women, they found that there were 61% of them had thick meconium [9].

In general, researches on different samples may get different rate of many colors of the fluid.

A study in the United States on 499,096 pregnant women noted that incidence of meconium changed from race to race, and the authors explained this changing base on the difference in the genetic response to the same conditions is different, geographical also affect the different rate [2].

4.2. Risk factors of MSAF

In table 1, we demanded about some risk factors of MSAF in term pregnancies. Of these, maternal age older than 30 years old and postdate pregnancies are two risk factors of the problem with level of significance < 0.05 and OR = 4.02 (95%CI: 2.95 - 5.48), OR = 3.94 (95%CI: 2.84 - 5.48), respectively. When PROM and labor in active phage are not risk factors with OR = 1.17 (95%CI: 0.86 - 1.59) and OR = 1.08 (95%CI: 0.80 - 1.48), respectively.

The length of labor and frequency of contractions are both higher in MSAF group, when the number of pregnancies is not statistic different between the two groups.

Many studies by some authors found similar result to ours. Naveen S. and his colleagues studied in 1009 pregnant women, found that risk factor of MSAF were primiparous (p = 0.0009), postdate pregnancies (p = 0.001), prolonged labors (p=0,034) and abnormal cord (0.001) [9]. Balchin I. and colleagues studied in 499096 pregnancies found risk factors were maternal fever (OR =1.62, 95% CI: 1.50 - 1.74), postdate pregnancies (OR = 1.39, 95% CI: 1.38 - 1.40), maternal BMI > 30 (OR = 1.37, 95% CI: 1.32 - 1.41), maternal age > 40 (OR = 1.26, 95% CI: 1.18 - 1.36) and PROM (OR = 1.04, 95% CI: 1.02 - 1.06) [2].

4.3. Records of CTG

In table 2, the rate of abnormal CTG is statistically significant difference between groups. And when compared with the clear fluid group, the MSAF group had higher rate of abnormal CTG, OR = 5.47, (95% CI: 3.57 - 8.38).

Many studies noted that MSAF group had high rate of abnormal CTG, however, we can't predict the fetus wellbeing base on this imagine only [11].

Study of Naveen S in 2006 found that MSAF group had 27% abnormal CTG, which is higher than clear fluid group [9]. A study in India found that MSAF group had 37% abnormal CTG when controls had only 25% [3]. Balchin I. also found that this group had 2.22 (95% CI: 2.17 - 2.07) times higher than controls included clear fluid women [2].

4.4. Outcomes

4.4.1. Rout of delivery

Table 3 shows that there was statistically significant difference in the rout of delivery between these groups. The rate of C-section in MSAF group is 52.4%, which is higher than the clear fluid group (24.9%), and this rate in the thick meconium fluid is the highest (77.0%).

When compared with the clear fluid group, MSAF women had 2.10 (95% CI: 1.72 - 2.57) times higher of C-section rate, of these the highest rate is of the thick-meconium group, which is 3.09 (95% CI: 2.53 - 3.77) times higher than controls.

MSAF is considered a sign of fetal distress [14], so obstetricians often perform C-section in these cases. Some authors indicate this procedure to prevent meconium aspiration syndrome [14]. Balchin I. and his colleagues noted that MSAF group had 1.40 (95% CI: 1.36 - 1.44, p < 0.001) times higher of C-section rate when compared with controls [2]. Narli N. when compared the rate of C-section between women with thick-meconium and others with light-meconium also noted the similar result in which C-section rate in thick-meconium group was higher than the other group [8]. Another study in Iraq also found that MSAF was one of the factors made it increase the rate of C-section [7].

To accurately diagnose the fetal wellbeing and decrease the rate of C-section in MSAF group, some authors recommended to use the scalp lactate testing [15]. This test may give the result as well as the scalp blood pH but with less volume of blood.

4.4.2. Birth weight

In table 4, babies with MSAF had birth weight less than controls (p < 0.001, 95% CI: 198.8 - 304.9 gr). There are many different results between studies in around the world when estimated the birth weight of MSAF group.

Krzyscin M. and his colleagues noted that the birth weight in this group was 3527 ± 581.4 gram [6], higher than our result. And another study in France also noted the birth weight was 3388 ± 549 gram [4], higher than our result, too. Both of these were performed in Europe, and ours was in Vietnam, this made the difference results between studies.

In a study with 278 pregnant women who had MSAF, authors found no statistically significant difference between thick-meconium and light-meconium babies (3068 ± 680 gram versus 3170 ± 722 gram, p = 0.336) [8]. This study also found no statistically significant difference in the rate of babies small for gestational age (SGA) between the two groups (23/221 versus 3/57, p = 0.192) [8]. However, a study in India with 1009 babies has MSAF found that SGA is a risk factor of MSAF. And the rate of SGA is different when the level of meconium in the amniotic fluid is changed, the rate of SGA in MSAF group is higher than the clear fluid group (13% versus 8%, p = 0.034), this rate in the thick-meconium group is 2.04 (95%CI: 1.84 - 3.51) times higher than the light-meconium group [9].

Kumari R. and his colleagues studied in 75 MSAF babies with GA at 37 weeks or more, found 40% of these had birth weight < 2500 gram [7]. Another study with 499096 babies with MSAF also found that, the risk of newborn weight under the 10th percentile in this group is 1.07 (95%CI: 1.03 - 1.11) times higher than controls [2].

4.4.3. pH of cord blood sample

In table 5, there was statistically significant difference in the value of pH of cord blood sample between MSAF subgroups and controls, newborns with MSAF had lower level of pH of cord blood sample when compared with clear fluid group.

And in table 6, babies with MSAF group had higher risk of academia when compared with controls, that was 4.39 (95%CI: 1.83 - 10.54) times higher, of these, thick-meconium was the highest, 7.13 (95%CI: 2.80 - 18.15) times higher, but light-green subgroup had no statistically significant difference compared with clear fluid group.

pH of cord blood sample takes an important role when estimate the acid-base balance of newborns, < 7.00 of this is one of the gold standard to diagnose asphyxia babies [1]. Many studies had as similar results as ours.

A study in Japan found that, the rate of acidemia babies (with pH of cord blood sample < 7.00) was statistically significant higher compared with clear fluid babies, and this difference was also statistically significant from week to week. Of these, in group of 37 to 41 weeks GA that was OR = 3.24 (95%CI: 1 - 10), and 41 to 43 weeks GA that was OR = 3.3 (95%CI: 1.3 - 8.3) [13]. Another study in Turkey found that this value was statistically significant lower in thick-meconium group when compared with light-meconium group [8].

Table 7 showed some risk factors of acidemia status in newborns with MSAF, of those only C-section was statistically significant correlated with the condition (χ^2 = 12,650, p < 0,001). C-section is usually performed in cases of signs of fetal distress (MSAF, abnormal CTG, IUGR...), so these babies are tend to be more severe when compared with the other groups. A similar result was noted in study of Nayeri F. and his colleagues, in which the rate of C-section was higher in group of babies with signs of asphyxia when compared with controls, (20% versus 3%, p = 0.0001) and OR = 28.5 (95% CI: 6.16 - 131.77) [10].

4.5. Predicting models for acidemia status of newborns with MSAF

As above, many factors were statistically significant correlate with acidemia status of newborns with MSAF, such as color of fluid, type of CTG, birth weight... In this study, we recommended some models which can predict the acidemia of newborns in this group using logistic regression model.

Yellowish-green group had only one case of acidemia, so we did not concern this color as a factor in models. Type 1 of CTG is considered normal, which we can exclude the status, so we did not concern this type of CTG, too.

According three factors, that were color of fluid, type of CTG and SGA status of babies, we concerned seven models to predict the acidemia of newborns as showed in table 8. And only three of them, which numbered 1, 2, and 3 were statistically significant predictable the status of the newborn, when the others were not.

5. CONCLUSIONS

In term pregnancies, maternal age older than 30 and postdate pregnancies are risk factors of MSAF. This group of pregnancies has higher rate of abnormal CTG, C-section, and acidemia babies: MSAF makes increasing the rate of C-section as much as 2.1 times, acidemia rate in MSAF group is 7.1% (4.39 times higher than controls); CTG type 3 or CTG type 2 with thick-meconium are predictable for acidemia status of MSAF newborns.

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