American Journal of Public Health Research, 2015, Vol. 3, No. 5A, 48-52
Available online at http://pubs.sciepub.com/ajphr/3/5A/11

DOI:10.12691/ajphr-3-5A-11

Meconium Aspiration Syndrome and Neonatal Outcome: A Prospective Study

Eva Gauchan*, Sahisnuta Basnet, Tejesh Malla

Department of Pediatrics, Manipal Teaching Hospital, Pokhara, Nepal
*Corresponding author: evagauchan@gmail.com

Abstract Meconium staining of amniotic fluid occurs in 10-15% deliveries and meconium aspiration syndrome occurs in 5% of those deliveries. Aspiration of meconium into the trachea results in various short and long term morbidities and variable mortality. These can be prevented by timely interventions before and after delivery. Aim of this study was to identify the neonatal factors associated with meconium aspiration syndrome and factors associated with mortality in these babies. The study included all babies admitted for meconium staining of amniotic fluid during the period of August 2013 till December 2014. Meconium aspiration syndrome was diagnosed if respiratory distress occurred immediately to within 24 hours after birth in a meconium stained baby, with radiological evidence of aspiration into the lungs and need for supplemental oxygen, after exclusion of other causes of respiratory distress. Data was analyzed by SPSS version 19 and presented as actual numbers and percentages. Associated factors were presented as Odds Ratio (OR) and 95% Confidence Interval. Chi-square test was done where applicable and a p-value <0.05 was taken as significant. Meconium aspiration syndrome was diagnosed in 50 out of 78 admitted newborns. Factors associated with meconium aspiration syndrome were respiratory distress starting immediately after birth, admission Downe score >4 and abnormal chest x-ray findings. Factors associated with mortality were small for gestational age newborns, 5 minute APGAR score <7, severe hypoxic ischemic encephalopathy, requirement for bag-mask ventilation and chest compression at birth and need for assisted ventilation. Neonatal morbidity and mortality in meconium aspiration syndrome is preventable by proper antenatal care and timely intervention after birth. Meconium-stained babies should be aggressively managed to prevent complications like perinatal asphyxia and respiratory failure which contribute to the mortality. Those babies having risk for adverse outcome should be managed with special focus on respiratory care with use of assisted ventilation and inhaled nitric oxide and extracorporeal membrane oxygenation, where available.

Keywords: *meconium aspiration syndrome, neonates, Nepal*

Cite This Article: Eva Gauchan, Sahisnuta Basnet, and Tejesh Malla, "Meconium Aspiration Syndrome and Neonatal Outcome: A Prospective Study." *American Journal of Public Health Research*, vol. 3, no. 5A (2015): 48-52. doi: 10.12691/ajphr-3-5A-11.

1. Introduction

Meconium staining of amniotic fluid complicates ~10-15% of deliveries primarily occurring in term and post-term deliveries [1]. It is rare before 34 weeks of gestation [2]. Meconium aspiration syndrome (MAS) occurs in 5% of those deliveries and ~30-50% require assisted ventilation [1,2,3]. MAS is associated with adverse perinatal outcome with mortality occurring in 3-5%. In recent years there has been a decline in the mortality due to improved obstetric practice and neonatal intensive care management. Our aim was to identify the neonatal factors associated with MAS and factors associated with adverse outcome in these babies.

2. Methodology

2.1. Study Setting and Period

This study was conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital of Western Nepal from August 2013 till December 2014.

2.2. Inclusion and Exclusion Criteria

We included all newborns ≥ 37 weeks of gestation admitted to NICU with history of meconium-staining of amniotic fluid in the study.

Babies born at < 37 completed weeks of gestation, absence of meconium in the amniotic fluid, respiratory distress due to other etiologies and presence of major congenital anomalies were excluded.

2.3. Data Collection

Details like gestational age, weight, type of delivery, APGAR scores at 1 and 5 minutes, consistency of meconium, details of resuscitation, tracheal suctioning, onset of respiratory distress, severity of perinatal asphyxia and radiological findings in the groups with and without MAS were collected. The consistency of meconium was divided into thick (opaque or "pea-soup like") and thin

(watery). Tracheal suctioning was done under direct laryngoscopic visualization if the baby was non-vigorous after birth, irrespective of the consistency of meconium. APGAR score at 1 and 5 minutes after birth was noted. Perinatal asphyxia (PA) was defined if baby failed to initiate spontaneous breathing at birth and was classified into severe (APGAR <3) and moderate (APGAR 4-6) at 1 minute after birth. Hypoxic ischemic encephalopathy (HIE) was staged according to Sarnat and Sarnat staging into mild, moderate and severe [4]. MAS was diagnosed if respiratory distress was present with radiological findings suggestive of meconium aspiration and need for supplemental oxygen, after exclusion of other causes for respiratory distress. Severity of respiratory distress was assessed using Downe score at the time of NICU admission.

2.4. Outcome Variable

In outcome, we tried to ascertain the various factors associated with MAS in babies born out of meconium-stained amniotic fluid. Then we tried to find out the factors associated with mortality in these babies.

2.5. Approval of Ethical Committee

Prior to commencing the study, ethical clearance was taken from the hospital ethical board. Written consent was taken from the guardians before undertaking the study.

2.6. Statistical Analysis

Statistical analysis was done by SPSS version 19. Data were presented as Odds ratio (OR) and 95% Confidence Interval (CI). Chi-square test was done where applicable and a value of <0.05 was taken as significant.

2.7. Sample Size Calculation

A pilot study was done prior to the study which showed proportion of abnormal chest x-ray in meconium aspiration syndrome cases was 0.9 and that in normal cases was 0.3. So with power 80%, significance level 5% and estimated risk difference 0.6; sample size required was 9 per group [5].

3. Results

Out of 4415 deliveries, meconium staining of amniotic fluid was seen in 595 (13.4%); 78 babies required admission to the Neonatal Intensive Care Unit. Male: female ratio was 1.68:1. Among them, 36 (46.2%) babies were born post-date and 15 (19.2%) were small for gestational age. Baby was born by vaginal delivery in 47 (60.3%) and cesarean delivery in 31 (39.7%) cases. Thick meconium was seen in 56 (71.8%) while in 22 (28.2%) cases it was thinly stained. Endotracheal suctioning was required in 46 (59%) cases; 67.9% of thick meconium and 36.4% of thin meconium stained babies. Respiratory distress was present immediately after birth in 63 (80.8%) cases while in 15 (19.2%) after 3 hours of birth. Chest x-ray showed evidence of meconium aspiration with or without complication in 55 (70.5%). MAS was diagnosed in 50 babies (1.13% of total deliveries; 8.4% of babies born through meconium-stained liquor). Table 1 shows the baseline demographics of babies with and without MAS.

Table 1. Characteristics of Neonates with Meconium Aspiration Syndrome and Meconium Stained Amniotic Fluid

Characteristics	MSAF* with MAS#	MSAF* without MAS#	P value
Cases	50 (64%)	28 (36%)	
M:F ratio	1.63:1	1.8:1	
Gestation (±SD) days	278.7 (±10.08)	279 (±8.74)	.891
Postdatism	24 (48%)	12 (43%)	.662
Small for gestational age babies	13 (26%)	2 (7%)	.043*
Birth weight (±SD) gms	2893.60(±558)	2946.79 (±433.6)	.642
Vaginal delivery	27 (54%)	20 (71%)	.131
APGAR score			
1 min <7	35 (70%)	15 (53%)	.147
5 min <7	12 (24%)	4 (14%)	.308
Thick meconium	37 (74%)	19 (68%)	.563
Tracheal suctioning done	30 (60%)	16 (57%)	.806
Respiratory distress at 0 hr	46 (92%)	17 (60%)	.001*
Downe score >4 at admission	27 (54%)	3 (10%)	.000*
Abnormal chest X-ray	49 (98%)	6 (21%)	.000*
Mortality	7 (14%)	0 (.0%)	.038*

MSAF*: Meconium Stained Amniotic Fluid
MAS #: Meconium Aspiration Syndrome

Analysis of factors associated with MAS showed respiratory distress within first three hours after birth (OR= 7.44; 95% CI: 2.08-26.56), Downe score at admission >4 (OR=9.7; 95% CI: 2.6-36.6) and abnormal chest x-ray findings (OR=179; 95% CI: 20.40-1583) were significantly more in the group with MAS than in the non-MAS group (Table 2). Postdatism, small for gestational age, vaginal delivery, thick consistency of meconium, tracheal suctioning and APGAR score <7 at 1 and 5 minutes were not significantly more in MAS as compared to no MAS. Seventeen babies required assisted ventilation; 7 (14% of MAS cases) were kept on nasal CPAP while 10 (20% of MAS cases) required mechanical ventilation.

Table 2. Odds of Various Factors Associated with Meconium Aspiration Syndrome in Babies With Meconium-Stained Amniotic Fluid

Variables	MAS	No MAS	OR (95% CI)	P value
Small for gestational age	13 (26%)	2 (7%)	4.5 (0.95-21.9)	0.0581
Postdatism	24 (48%)	12 (43%)	1.23(0.48-3.12)	0.6622
Vaginal delivery	27 (54%)	20 (71%)	0.46 (0.17-1.26)	0.1348
Thick meconium	37 (74%)	19 (68)	0.74 (0.27-2.04)	0.5637
Tracheal suctioning done	30 (60%)	16 (57%)	1.12 (0.44-2.87)	0.8057
1 min APGAR <7	35 (70%)	15 (53%)	2.02 (0.77-5.27)	0.1496
5 min APGAR <7	12 (24%)	4 (14%)	1.89 (0.54-6.55)	0.3131
Respiratory distress at 0 hr	46 (92%)	17 (60%)	7.44 (2.08-26.56)	0.0020*
Downe score >4 at admission	27 (54%)	3 (10%)	9.7 (2.6-36.6)	0.0007*
Abnormal chest X-ray	49 (98%)	6 (21%)	179 (20.40-1583)	<0.0001*

Seven (14%) babies with MAS died after admission. Risk factors for mortality were small for gestational age (OR=7.2; 95% CI: 1.42-37), 5 minute APGAR <7 (OR=6.5; 95% CI:1.29-33.1), severe HIE (OR=5.9; 95% CI:1.11-31.3), requirement for chest compression (OR=25.8; 95% CI:3.31-201.7), bag-mask ventilation (OR=9.9; 95% CI:1.71-57.05) at the time of delivery and need for assisted ventilation, either bubble CPAP and /or mechanical ventilator after admission (OR=87.8; 95% CI:4.66-1656.2) (Table 3). Consistency of meconium, tracheal suctioning, Downe's score at admission and duration of oxygen requirement did not significantly affect the outcome.

Table 3. Odds of Various Factors Associated with Neonatal Mortality in Meconium Stained Amniotic Fluid

Variables	Died	Survived	OR (95% CI)	p value
Small for gestational age	4 (57%)	11 (15%)	7.2 (1.42-37)	0.0170*
Postdatism	2 (28.6%)	34 (48%)	0.4 (0.07-2.39)	0.3389
Vaginal delivery	3 (43%)	44 (62%)	0.46 (0.09-2.21)	0.3332
Thick meconium	5 (71.4%)	51 (71.8%)	1.02 (0.18-5.69)	0.9820
Tracheal suctioning	7 (100%)	39 (55%)	12.3 (0.67-224.3)	0.0894
5 min APGAR <7	4 (57%)	12 (17%)	6.5 (1.29-33.1)	0.0230*
Downe score >4	5 (71.4%)	25 (35%)	4.6 (0.83-25.4)	0.0804
Oxygen requirement > 48 hrs	5 (71.4%)	52 (73%)	1.09 (0.19-6.1)	0.9179
Severe HIE	3 (43%)	8 (11.3%)	5.9 (1.11-31.3)	0.0369*
Chest compression	3 (43%)	2 (2.8%)	25.8 (3.31-201.7)	0.0019*
Bag-Mask ventilation at delivery	3 (43%)	5 (7%)	9.9 (1.71-57.05)	0.0103*
Need for assisted ventilation	7 (100%)	10 (14%)	87.8 (4.66-1656.2)	0.0028*

Among the babies who died, 5 (71.4%) had thick meconium (p=0.982), tracheal suctioning (p=0.021) was done in all (100%) and all the cases had moderate to severe MAS (p=0.001).

Discussions

Meconium is a thick, green viscous substance composed of epithelial cells, vernix, lanugo, mucus, amniotic fluid, intestinal secretions, etc. Aspiration of meconium into the lungs results in a condition termed as meconium aspiration syndrome (MAS) leading to obstruction of the airways by meconium, loss of surfactant and chemical pneumonitis. The syndrome manifests as respiratory distress immediately or within a few hours after birth, hypoxemia, hypercapnia and acidosis. MAS can result in mortality in the newborn period or can have complications like persistent pulmonary hypertension, long term residual respiratory complications [2,6,7,8] and neurodevelopmental problems [2,8,9].

Our study found MAS prevalence of 8.4% in babies born with meconium stained amniotic fluid. A study conducted in our institute previously showed a prevalence of 8.5% [10]. Other studies have found rates as low as 4.5% [11] to as high as 18% [12]. This probably reflects the level of antenatal care in different countries.

Several studies have quoted postdatism [13,14,15] and small for gestational age [8,16] as being associated with MAS. In our study postdatism was seen in 36 (46.2%) cases but this was not statistically significant (p=0.66). Similarly small for gestational age was found in 15 (19.2%) cases (p=0.05). Some studies have shown MAS to be more common in babies born through vaginal route [8,17,18] while there are other studies which show MAS occurring more in cesarean deliveries [19,20,21]. However we could not find any association between MAS and the mode of delivery. Thick meconium has been associated with MAS [11,14,21,23] and tracheal suctioning has been identified as a risk factor for severe MAS [21]. In our study there was no correlation between the consistency of meconium and MAS. Similarly tracheal intubation and suctioning did not show any association with MAS. One and five minute APGAR score have been found to be less than 7 in many studies [8,12,15,17,21,22,23,24]. We did not find any statistical difference in the 1 and 5 minute APGAR score in babies with and without MAS (p=0.14 and 0.31). Respiratory distress which started immediately after birth (p=0.002), Downe score of > 4 at time of NICU admission (p=0.0007) and abnormal chest X-ray findings (p=<0.0001) were found in babies who developed MAS. Similarly, other studies also found respiratory distress started immediately after birth [12,24,25,26] and abnormal chest x-ray in most cases of MAS [9-10,23]. Those babies

who developed MAS had oxygen requirement lasting > 48 hrs; this finding was 18 times more than in those who did not develop MAS (p=0.0063).

Almost 30-50% of MAS babies require assisted ventilation; either CPAP and/or mechanical ventilation [1,2,3,21,27,28]. Out of the MAS cases, 17 (34%) required assisted ventilation (p=<.001); 10 (20%) required mechanical ventilation while 7 (14%) nasal CPAP; of which 7 (70%) of ventilated babies died while none of the babies who received CPAP died. In our study death occurred in 14% of MAS cases. Other studies have quoted mortality rates of 2.7-33% [1,10,11,13,14,24,25,29]. The wide variation in mortality results due to the difference in the levels of care in various neonatal facilities across the world and the availability of adjunctive therapies like nitric oxide and extracorporeal membrane oxygenation (ECMO) in some and not all facilities. Nepal being a developing country, our hospital lacks the aforementioned facilities. Many studies have associated severe asphyxia as a risk factor for mortality in babies with MAS [13,14,21,25,30,31,32]. Similarly requirement for resuscitation at the time of delivery [30], low 1 and 5 minute APGAR score and need for assisted ventilation after admission were noted as a risk in some studies [25,31]. In our study, small for gestational age (p=0.017), 5 minute APGAR <7 (p=0.023), severe HIE (p=0.037), requirement for chest compression (p=0.0019) and bag-mask ventilation (p=0.01) after tracheal suctioning and need for assisted ventilation (p=0.0028) were factors associated with increased risk for mortality.

Conclusion

MAS remains an important cause of morbidity as well as mortality in term and post-term newborns. In meconium-stained babies, MAS is more likely in presence of respiratory distress starting immediately after birth, admission Downe score >4 and abnormal chest x-ray findings. It has an adverse outcome in small for gestational age newborns, low 5 minute APGAR score, requirement for resuscitation at the time of delivery, severe HIE and need for assisted ventilation. In order to reduce the mortality associated with MAS, we need to prevent small for gestation births, aggressively manage non-vigorous babies born out of meconium-stained amniotic fluid and prevent severe asphyxia which is a contributing factor to mortality in these babies.

List of Abbreviations

MAS: Meconium aspiration syndrome; MSAF: Meconium stained amniotic fluid; NICU: Neonatal intensive care unit; PA: Perinatal asphyxia; HIE: Hypoxic ischemic encephalopathy; CPAP: Continuous positive airway pressure.

Acknowledgements

We would like to thank Dr. Sandip Singh, Dr. Rajnish Mishra and Dr. Laxmi KC for their help in conducting this study.

Declaration of Conflicting Interests

The authors declare that there is no potential conflicts of interest with respect to the research, authorship and /or publication of this article.

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

References

[1] Wiswell TE, Tuggle JM, Turner BS. Meconium aspiration syndrome: have we made a difference?. *Pediatrics*. 1990; 85(5): 715-721.

[2] Yeh TF. Core Concepts: Meconium Aspiration Syndrome: Pathogenesis And Current Management. *NeoReviews*. 2010. 11(9). e503-e512.

[3] Goldsmith JP. Continuous Positive Airway Pressure And Conventional Mechanical Ventilation In The Treatment Of Meconium Aspiration Syndrome. *J Perinatol*. 2008.28. S49-S55.

[4] Sarnat HB, Sarnat MS. Neonatal Encephalopathy Following Fetal Distress: A Clinical and Electroencephalographic Study. *Arch Neurol*. 1976;33(10): 696-705.

[5] Sathian B, Sreedharan J, Baboo NS, Sharan K, Abhilash ES, Rajesh E. Relevance of Sample Size Determination in Medical Research. *Nepal J Epidemiol*. 2010;1: 4-10.

[6] MacFarlane PI. Heaf DP. Pulmonary Function In Children After Neonatal Meconium Aspiration Syndrome. *Arch Dis Child*. 1988;63:368-372.

[7] Khan AM, Elidemir O, Epstein CE, Lally KP, Xue H, Blackburn M., et al. Meconium Aspiration Produces Airway Hyperresponsiveness And Eosinophilic Inflammation In A Murine Model. *Am J Physiol Lung Cell Mol Physiol*. 2002;283(4). L785-L790.

[8] Chandran JR, Uma DN, Rajeshwary U. Risk Factors For Meconium Aspiration And Mas (Meconium Aspiration Syndrome) In Neonates Born Through Meconium Stained Amniotic Fluid (Msaf) In A Tertiary Care Centre In Malabar (Kerala). *Journal of Evolution of Medical and Dental Sciences*. 2013;2 (49):9489-9495.

[9] Zoe I, Charalampos G, Charalampos S, Georgios C, Michail V, Nikolaos V. *Association of Meconium Stained Amniotic Fluid with Fetal and Neonatal Brain Injury*, INTECH Open Access Publisher, 2012.

[10] Swain P, Thapalial A. Meconium Stained Amniotic Fluid – A Potential Predictor Of Meconium Aspiration Syndrome. *Journal of Nepal Paediatric Society*. 2008; 28(1); 3-6.

[11] Hanoudi BM, Murad AM, Ali AD. Meconium Staining of Amniotic Fluid: A Clinical Study. *Br J Med Med Res*. 2014; 4(3):914-921.

[12] Firdaus U, Ali SM, Sachdeva S. Maternal and neonatal factors associated with meconium stained amniotic fluid. *Current Pediatr Res*. 2013;17 (1):37-40.

[13] Rajput U, Jain A. Impact of Meconium Stained Amniotic Fluid on Early Neonatal Outcome. *Journal of Evolution of Medical and Dental Sciences*. 2013;2(45):8788-8794.

[14] Bhatia, P, Ela N. Fetal and neonatal outcome of babies in meconium stained amniotic fluid and meconium aspiration syndrome. *J Obstet Gynecol India*. 2007;57 (6):501-504.

[15] Lee K, Mi LS, Jin YH, Park C, Mazaki-Tovi S, Hyun YB, et al. The frequency of meconium-stained amniotic fluid increases as a function of the duration of labor. *J Matern Fetal Neonatal Med*. 2011;24(7):880-885.

[16] Vivian-Taylor J, Sheng J, Hadfield R, Morris J, Bowen J, Roberts C. Trends in obstetric practices and meconium aspiration syndrome: a population-based study. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2011;18(13): 1601-1607.

[17] Hiremath PB, Bahubali G, Meenal C, Bansal N, Ragaramya. The Management Practices and Outcome of Meconium Stained Amniotic Fluid. *Int J Biol Med Res*. 2012;3(3): 2204-2207.

[18] Ramakishore AV, Subramanyam KL, Mahesh G. A study on meconium aspiration syndrome cases attending to Government

general hospital, Anantapuramu, Andhra Pradesh. *Int J Res Health Sci* [Internet]. 2015; 3(1): 169-173.

[19] Naqvi SB., Manzoor S. Association of meconium stained amniotic fluid with perinatal outcome in pregnant women of 37-42 weeks gestation. *Pak J Surg*, 2011;27(4): 292-298.

[20] Khatun, H.A., Arzu, J., Haque, E., Kamal, M.A., Al Mamun, M.A., Khan, M.F.H., et al, "Fetal outcome in deliveries with meconium stained liquor," *Bangladesh J Child Health.* 2009;33(2): 41-45.

[21] Fischer, C., Rybakowski, C., Ferdynus, C., Sagot, P., Gouyon, J.B., "A population-based study of meconium aspiration syndrome in neonates born between 37 and 43 weeks of gestation," *International Journal of Pediatrics.* 2012;1-7.

[22] Khazardoost, S., Hantoushzadeh, S., Khooshideh, M., Borna, S., "Risk factors for meconium aspiration in meconium stained amniotic fluid," *J Obstet Gynaecol.* 2007;27(6): 577-579.

[23] Kumari, S., Gupta, S.N., Mahato, I.P., Giri, R., Yadav, A., Thakur, A., et al, "Maternal and fetal outcome in term labour with meconium stained amniotic fluid," *Health Renaissance.* 2012; 10(3): 198-202.

[24] Espinheira, M., Grilo, M., Rocha, G., Guedes, B., Guimarães, H., "Meconium aspiration syndrome - the experience of a tertiary center," *Revista Portuguesa de Pneumologia* (English Edition). 2011;17(2):71-76.

[25] Louis, D., Sundaram, V., Mukhopadhyay, K., Dutta, S., Kumar, P., "Predictors of mortality in neonates with meconium aspiration syndrome," *Indian Pediatrics.* 2014: 51: 637-640.

[26] Hofer, N., Jank, K., Resch, E., Urlesberger, B., Reiterer, F., Resch, B., "Meconium Aspiration Syndrome – a 21-years' Experience from a Tertiary Care Center and Analysis of Risk Factors for Predicting Disease Severity," *Klin Padiatr*, 2013;225(07); 383-388.

[27] Wiswell, T., Gannon, C., Jacob, J., Goldsmith, L., Szyld, E., Weiss, K., et al, "Delivery Room Management of the Apparently Vigorous Meconium-stained Neonate: Results of the Multicenter, International Collaborative Trial," *Pediatrics.* 2000;105(1):1-7.

[28] Dargaville, P., "Respiratory Support in Meconium Aspiration Syndrome: A Practical Guide," *International Journal of Pediatrics.* 2012: 1-9.

[29] Velaphi, S.,Van Kwawegen, A., "Meconium aspiration syndrome requiring assisted ventilation: perspective in a setting with limited resources," *Journal of Perinatology*. 2008; 28:S36-S42.

[30] Lin, H., Wu, S., Wu, J., Yeh, T., "Meconium aspiration syndrome: experiences in Taiwan," *Journal of Perinatology*, 2008;28: S43-S48.

[31] Anwar, Z., Butt, T.K., Anjum, F., Kazi, M.Y., "Mortality in meconium aspiration syndrome in hospitalized babies," *Journal of the College of Physicians and Surgeons Pakista*. 2011;21(11): 695-699.

[32] Dargaville, P., Copnell, B., "The Epidemiology of Meconium Aspiration Syndrome: Incidence, Risk Factors, Therapies and Outcome," *Pediatrics.* 2006; 117(5): 1712-1721.