East African Medical Journal Vol. 83 No. 8 August 2006
SEVERE MECONIUM ASPIRATION SYNDROME: CASE REPORT
R. Koigi-Kamau, MBChB, MMed (O/G), Senior Lecturer, Department of Obstetrics and Gynaecology, College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya and Chairman, Division of Obstetrics & Gynaecology, The Nairobi Hospital, Nairobi, Kenya and E.C. Kungu, MBChB, MMed (Paed), Neonatology (MacGill), Consultant Paediatrician and Neonatologist, The Nairobi Hospital, P.O. Box 52545-00200, Nairobi, Kenya

Request for reprints to: Dr. R. Koigi-Kamau, Department of Obstetrics and Gynaecology, College of Health Sciences, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya

SEVERE MECONIUM ASPIRATION SYNDROME: CASE REPORT

R. KOIGI-KAMAU and E.C. KUNGU

SUMMARY

This is a case report on severe meconium aspiration syndrome (MAS) that resulted in early neonatal death. Antenatal care was provided at a low-cost non-governmental organization (NGO) clinic. First stage of labour lasted for only 2 hours and 45 minutes. There were no foetal heart rate abnormalities that were noted during the first stage of labour. Artificial rupture of membranes was done in second stage of labour. There was no liquor amnii seen but scanty thick old meconium was noted. Delivery was easy. The baby's skin, nails, umbilical cord, placenta and vernix were deeply stained yellow with old meconium. Resuscitation included suction through direct laryngoscopy, nasotracheal intubation with pulmonary toilet, as well as administration of 100% oxygen. The condition of the baby did not improve. A diagnosis of severe MAS with hypoxic ischaemic encephalopathy (HIE), persistent pulmonary hypertension (PPH), persistent foetal circulation syndrome (PFCS) and meconium chemical pneumonitis was made. The baby was admitted to the intensive care unit (ICU) for assisted ventilation and critical care. The condition of the baby continued to deteriorate and demise occurred 18 hours after birth. The pathophysiologic processes of intrauterine meconium release, mechanisms of foetal effects and dilemmas in management are discussed.

INTRODUCTION

Meconium passage is a developmentally programmed postnatal event and an indicator of the integrity of the newborn's gastrointestinal system, with 98% of healthy infants passing meconium within 48 hours (1). On the other hand, meconium release in utero still remains enigmatic and a challenge to both obstetricians and neonatologists. The mechanisms that trigger meconium release are not well understood, hence making prediction of its occurrence difficult. However, evidence that birth asphyxia is an important sequel of intrauterine meconium release has been overwhelming over time (1-3).

The significance of intrauterine meconium release is that it is associated with variable levels of neonatal morbidity and mortality. The chemical constituents of meconium such as bile acids, cytokines and phospholipase A_2 may have deleterious effects on umbilical cord, lungs and foetal brain while the foetus is still in utero (1), and hence prejudicing extra-uterine survival. The most undesirable outcome in these circumstances is meconium aspiration syndrome, the severest of which is dependent on the thickness of meconium and the duration since intrauterine meconium release took place (1,3).

The pathophysiologic mechanisms that result from meconium aspiration in utero are diverse and the effects far reaching. Presence of particulate matter in the lungs induces chemical pneumonitis (4) and prevents surfactant production through damage of the alveoli and type II pneumocytes (5). Infective pneumonitis is also likely to occur as a result of lowered zinc content and suppressed macrophage phagocytic activity by meconium (1,6).

In addition, vascular injury due to inflammatory cytokines affect pulmonary vasculature integrity, hence compromising further surfactant production and alveolar function (4, 7). Prolonged exposure of foetal lungs to meconium also induces permanent intimal muscular hypertrophy in the pulmonary arterioles (8,9).

It is these changes that result in the manifestation of the clinical syndrome of severe MAS after birth, when pulmonary function is called upon to take over the role of gaseous exchange. Pulmonary arteriolar changes result in persistent pulmonary hypertension (PPH), which triggers a vicious cycle of hypoxia and metabolic acidosis – inducing further vasoconstriction (4). PPH further aggravates the situation through encouraging shunting of blood from right to left through persistent ductus arteriosus and foramen ovale and hence maintaining the foetal circulation (1).

At the bottom line, neonatal asphyxia is the undesired outcome of MAS and the commonly associated hypoxic-ischaemic encephalopathy (HIE) (2). These undesirable effects of meconium production in utero constitute the challenge to obstetricians in terms of accurate prediction and timely intervention, and for the neonatologist, effective postnatal management.

The purpose of this case report is to discuss and review literature on MAS in order to provide further insight on the understanding of the mechanisms of meconium production in utero, meconium-associated pathophysiological processes, impact of intrauterine meconium release on pregnancy outcome, as well as management challenges.

CASE REPORT

The mother was a 31 year old para 1 gravida 2 legal officer. Her expected date of confinement was 17th October, 2005. The first delivery was normal.

She had comprehensive antenatal care at an urban low-cost NGO clinic but preferred to deliver at the Nairobi Hospital. For this reason, she was referred to the principal author at 36 weeks of gestation for booking, but continued with antenatal care at the NGO clinic.

There was nothing alarming at the time. Routine antenatal investigations were normal - haemoglobin concentration (13.2 gm/dl); Venereal Disease Research Laboratory (VDRL) test (none reactive); Human immunodeficiency virus (HIV) ELISA test (negative); Blood group (AB Rhesus positive). Obstetric scan had not been done.

She was admitted to the Nairobi Hospital at 40 weeks of gestation in established labour and drainage of liquor. There was no history of draining amniotic fluid. The fundal height was term and the lie was longitudinal. The foetus was in cephalic presentation and in occipito-anterior position. The foetal head was three-fifths above the pelvic brim. The foetal heart rate was 120–127 beats per minute and regular. On vaginal examination, the cervix was central, parous, 4 cm dilated. The membranes and umbilical cord were not felt, and no liquor amnii was seen. A diagnosis of active phase of labour was made.

Labour progressed fast, reaching full cervical dilatation within 3 hours since admission. The foetal heart rate remained within normal range. Membranes were found to be still intact but flat against the foetal scalp. Amniotomy was done. Only scanty, thick, yellow, old and highly particulate meconium was noted without any obvious amniotic fluid component. Spontaneous vertex delivery was achieved easily without episiotomy. There was neither moulding nor caput succedaneum. Oral and nasopharyngeal suction were done at delivery of the head prior to onset of breathing. Delivery was completed and a normal looking term male baby handed over to the neonatologist. The placenta was delivered by controlled cord traction. The lower genital tract and the perineum were intact. The uterus was well contracted and there was no vaginal bleeding. She was put on amoxicillin with clavuliic acid and mefanemic acid. At this point, she indicated, retrospectively, that she had experienced severe reduction of foetal movements about a week earlier, which she did not report to health providers.

The neonate's skin and nails, as well as the umbilical cord and the foetal aspect of the placenta, were deeply stained with thick yellowish meconium. The APGAR rating was very low – 4 at 1 minute, 5 at 5 minutes and 6 at 10 minutes. The birth weight was 3.5 kg, the length 52cm and the head circumference 36 cm.

At the resuscitation table, oral and nasopharyngeal suction was continued with and direct laryngoscopy done to enable suction of thick meconium in the trachea and upper airway. Naso-tracheal intubation was done to facilitate pulmonary toilet with warm saline as well as intermittent

ventilation with an Ambu Bag. Once spontaneous respiration was well established, she was extubated. She was given 7ml of 25% dextrose intravenously and transferred to the high dependency unit of the nursery, where close monitoring was maintained. Respiratory support with 100% oxygen was given and intravenous infusion with 10% dextrose with added calcium gluconate started.

The baby remained tachypnoeic with staccato breathing. The heart rate remained markedly elevated (150 - 170 beats per minute). Response to stimulation was by a weak cry and spontaneous movements of all limps. Despite adequate respiratory effort and administration of 100% oxygen, she remained cyanosed with percentage oxygen saturation (SPO_2) of 70%. This was suggestive of right-to-left shunting of blood through patent ductus arteriosus and foramen ovale. A diagnosis of severe meconium aspiration syndrome (MAS) associated with meconium chemical pneumonitis, persistent pulmonary hypertension, persistent foetal circulation syndrome (PFCS) and hypoxic ischaemic encephalopathy (HIE) was made.

Respiratory function deteriorated further and SPO_2 continued to fall. Six hours after delivery, she was re-intubated, suction done and intermittent pressure ventilation with Ambu Bag instituted and transferred to the intensive care unit (ICU) for critical care. Intravenous fluids were maintained and serum electrolytes assayed. A chest radiograph was taken, which showed global radio-opacity of lung parenchyma with hardly any areas of radio-translucency.

In ICU, the condition of the baby continued to deteriorate further. The neonate remained tachypnoeic with tachycardia, rising PCO_2, persistently subnormal SPO_2 and progressive decrement of responsiveness to stimulation.

After 18 hours of management, the baby had a cardiac arrest and was certified dead.

DISCUSSION

The case presented was an apparently normal full term neonate with typical presentation of severe MAS. All the effects of meconium, ranging from cutaneous features of meconium staining (1) to pulmonary (7,10), cardiovascular (11) and neurological sequel (1), were manifested. Although echocardiographic doppler evidence of patent ductus arteriosus and patent foramen ovale were not adduced in this case, clinical auscultation and failure to achieve the desired outcomes of aggressive resuscitation measures were sufficient to accurately make the diagnosis of persistent foetal circulation. By inference, persistent foetal circulation syndrome (PFCS) could only have been a sequel of PPH. Evidence in support of PPH was adduced from the global opacity of lung fields on the chest radiograph, which depicted severe pulmonary pathology.

The meconium in this case was highly particulate. Its physical occupation in bronchioles and alveoli could have contributed to the global opacity of the lung fields, in addition to the severe meconium-induced cardiopulmonary pathophysiological processes. These include the occurrence of secondary widespread chemical pneumonitis as a result of the constituents of meconium, as well as pulmonary arteriolar vasculopathy (4). These pathophysiologic changes that lead to PPH secondarily lead to persistent foetal circulation. The overall impact despite resuscitation efforts was persistence of hypoxemia and hypercapnia despite ventilation with 100% oxygen.

The deep yellowish meconium staining found on cutaneous tissues, umbilical cord and placenta is an indication of prolonged exposure to thick meconium (1). Based on this observation, it can be postulated that the aetiology of brain damage in this case may have been threefold: intrauterine brain damage as a result of meconium-generated cytokines, placental and umbilical cord-derived foetal hypoxia, and neonatal asphyxia due to cardiopulmonary meconium-initiated insufficiency. That the mother retrospectively reported having experienced virtually no foetal movements for several days during the previous gestational week ascertains the possibility of a prolonged episode of intrauterine hypoxia, which may have been the trigger for the intrauterine meconium release in this case. In addition, there was a long time enough for severe permanent chemical and anatomic pulmonary changes to take place.

This case of MAS represents only the tip of ice-bag of similar but unreported situations all over the world. The remarkable universal tripartite scenario is that of consternation of the obstetrician as a result of unpleasant or unrewarding outcome of the delivery process; the helplessness of the neonatologist as ineffectual resuscitation measures fail to provide

the desired outcome of adequate pulmonary gaseous exchange; and the reactive depression in the parents as their newborn's life fades away.

The corollary is also true – that if the mother was knowledgeable on significance of reduced maternal perception of foetal movements as an indicator of intrauterine hypoxia (1), most likely the neonate would have been salvaged through immediate delivery once the foetal movements slowed down. Since she was already at a term gestation when foetal movements had slowed down, it may have not been absolutely necessary to perform any further assessment of foetal well-being before instituting delivery measures.

CONCLUSION

In severe MAS, as was the case with the neonate presented, the pathophysiologic events start in utero when exposure to meconium in the amniotic fluid is prolonged. Since there is no simple way of recognising meconium release in utero, the challenge remains the identification of accurate predictors of meconium release in order to allow appropriate and timely interventions. As a general principle, it is appropriate to state that any condition that is likely to be associated with intrauterine hypoxia should be investigated and delivery instituted if gestation of viability is reached, both as a prophylaxis against intrauterine morbidities such as MAS and perinatal mortality in general. Also notable is that diagnosis of MAS as applied today is a misnomer. In order to encompass the associated adverse intrauterine pathophysiologic events, a more appropriate terminology such as foetal meconium syndrome (FMS) or meconium aspiration foetal syndrome (MAFS) should be adopted.

ACKNOWLEDGEMENTS

The Nairobi Hospital labour ward, High Dependency Neonatal Unit and Intensive Care Unit for the commitment shown in trying to salvage the life of the full term neonate presented here. The role of Raphael Euppah (Librarian) and Peter Odawa (Assistant Librarian) in helping in extensive literature search is highly appreciated.

REFERENCES

1. Ahanya S.N., Lakshamanan J., Morgan B.L.G., *et al.* Meconium passage in utero: mechanisms, consequences and management. *Obstet. Gynecol.* 2005; **60:** 45-56.
2. Milson I., Ladfors L., Thrimger K., *et al.* Influence of maternal, obstetric and foetal risk factors on prevalence of birth asphyxia at term in Swedish urban population. *Acta. Obstet. Gynecol. Scand.* 2002; **81:** 909-917.
3. Regalia A.L., Patregnani C., Ratti M., *et al.* Prognostic value of change in amniotic fluid color during labor. *Foetal Diagn. Ther.* 2005; **20:** 5-9.
4. Ghidii A. and Spong C.Y. Severe meconium aspiration syndrome is not caused by aspiration of meconium. *Amer. J. Obstet. Gynecol.* 2001; **185:** 931–938.
5. Tyler D.C., Murphy J. and Cheney F.W. Mechanical and chemical damage to long tissue caused by meconium aspiration. *Pediatrics.* 1978; **62:** 454-459.
6. Lembet A., Gaddipati S., Holzman I.R., *et al.* Meconium enhances the growth of perinatal bacterial pathogens. *Mt. Sinai J. Med.* 2003; **70:** 126-129.
7. Kojima T., Hattori K., Fujiwara I., *et al.* Meconium-induced lung injury medicated by activation of alveolar macrophages. *Life Sci.* 1994; **54:** 1559-1562.
8. Katz V.L. and Bowes W.A. Meconium aspiration syndrome: reflections on a murky subject. *Amer. J. Obstet. Gynecol.* 1992; **166:** 171-183.
9. Thureen P., Hall D.M., Hoffenberg A., *et al.* Foetal meconium aspiration inspite of appropriate airway management: Pulmonary and placental evidence of prenatal disease. *Amer. J. Obstet. Gynecol.* 1997; **176:** 967-975.
10. Manning F.A., Harman C.R., Morrison I., *et al.* Foetal assessment based on foetal biophysical profile scoring IV. An analysis of perinatal morbidity and mortality. *Amer. J. Obstet. Gynecol.* 1990; **42:** 703-709.
11. Hannandez C., Little B.B., Dax J.S., *et al.* Prediction of severity of meconium aspiration syndrome. *Amer. J. Obstet. Gynecol.* 1993; **169:** 61-70.