ORAL PRESENTATIONS

CAN WE DECREASE THE INCIDENCE OF PERINATAL MORTALITY IN THE COW?

Szenci, O.

Clinic for Large Animals, Faculty of Veterinary Science, Szent István University, Üllő-Dóra major, H-2225 Hungary; szenci.otto@aotk.szie.hu

SUMMARY

During the last decades there has been a trend of increasing rates of stillbirths (death of a mature calf foetus during calving and the first 24 h pp) especially in Holstein Frisian heifers. The cause of stillbirth with a non-infectious aetiology is likely to be multifactorial, but the majority of stillbirth might be caused by direct and indirect asphyxia. In practice it is generally not possible to measure the acid-base metabolism of foetuses therefore it is very important to know those changes which may occur during normal calving and obstetrical assistance in order to be able to decrease perinatal mortality.

Keywords: perinatal mortality, newborn calves, acid-base disturbance, acidosis

The profitability of cattle breeding is greatly influenced by the rate of calves being born alive and reared to adulthood. In spite of the speedy developments of animal breeding, perinatal mortality is still very high (4 to 7%) and constitutes approximately half of the total calf losses (Anderson and Bellows, 1967; Voelker, 1967; Szenci and B.Kiss, 1982; Mee, 1991). Perinatal mortality (stillbirth) is defined as the death of mature calf foetuses during calving or in the first 24 h of postnatal life.

During the last decades there is a trend of increasing rates of stillbirths especially in Holstein Friesian (HF) heifers. In the Swedish HF-heifer population stillbirth rate has increased from 4% to 11% (Gustafsson et al., 2004). As other authors found, at first calving around 10% of the calves are born dead or die on the first day (Berlgund et al., 2003; Meyer et al., 2000; Steinbock et al., 2003). In the Netherlands stillbirth rate for heifers was reported to be 12,2% in 1999, and in the USA it was 13,2% in 1996 (Steinbock et al., 2003).

The incidence rate of stillbirths (294 out of 4103) in a large-scale Hungarian Holstein-Friesian dairy farm between 1973 and 1978 was 8,3% for heifer calvings and 6,5% for cow calvings, respectively (Szenci et al., 1981). In the same farm the stillbirth rate was 8,7% for heifer calvings and 5,9% for cow calvings in 2003, respectively. All together 124 of 1733 newborn calves were lost (7,2%) in the perinatal period. Comparing the two periods there were no increase in perinatal mortality, however it is still very high. These figures call attention to the importance of examining the causal factors of perinatal mortality.

The cause of stillbirth with a non-infectious aetiology is likely to be multifactorial but the majority of calves might die due to direct and indirect asphyxia because in 73 to 75% of the calves that died in the perinatal period no pathological changes were detected (Hahnsdorf, 1967;

Greene, 1979). In a recent study, occurrence of asphyxia in calves dying perinataly was 58.3% (Schuijt, 1990).

As a result of disturbances in the uteroplacental circulation occurring during parturition due to the rupture of foetal membranes and uterine contractions, all calf foetuses develop more or less severe hypoxia and consequently acidosis. The foetus responds to hypoxia by an oxygen-conserving adaptation of its circulation. This means that all organs, that are not essential for intra-uterine life (lungs, spleen, thymus, muscles and skin, gastrointestinal tract, possible also the liver and kidneys) are supplied with minimum blood. Oxygen is spared for essential organs like the brain, heart and adrenal glands. Increased heart rate (tachycardia), blood pressure and blood flow are also observed. In the case of relatively high hypoxaemia the frequency of heart activity decreases (bradycardia). Circulation changes and reduced oxygen consumption result in oxygen tension in the blood being maintained within physiological limits for some time. This oxygen-conserving adaptation, however, means anaerobic glycolysis in all tissues with minimum blood supply. Under normoxic conditions glucose as the main energy source is reduced to pyruvate via the citric-acid cycle. The first step to pyruvate is anaerobic, the second step consists of oxidation of pyruvate via the citric-acid cycle to the final products, CO_2 and H_2O. During oxygen shortage glucose can only be metabolised anaerobically to pyruvate, which is mostly reduced to lactic acid. Energy output in this process is small, but it is sufficient to maintain metabolism for some time. Anaerobic glycolysis, however, has a great disadvantage because energy production is reduced, the carbohydrate reserves are rapidly exhausted and metabolic acidosis develops by accumulation of acid metabolites (lactic acid). At birth all foetuses therefore suffer from a respiratory as well as metabolic acidosis. It is the degree of acidosis that finally determines whether the foetus lives or dies. Vital cell functions cannot take place in severe acidosis, at a blood pH value of 6.7 foetal life ends. Before that, the organism's regulatory system of chemical buffering in the blood comes into operation to keep the offspring alive. Bicarbonate is the most important buffer. The others are haemoglobin, plasma proteins and phosphate buffers (Walser and Mauer-Schweizer, 1978; Eigenmann et al., 1983a; Szenci, 1984; Grunert et al., 1985).

The duration of survivable asphyxia always depends on the reserves of glycogen in the heart muscle (Dawes, 1968). The surviving period for calves with induced anoxia is between 4 to 6 minutes: four of 6 foetuses subjected to 4 minutes of anoxia survived whereas all others died when the umbilical cord was clamped for 6 or 8 minutes (Dufty and Sloss, 1977).

The degree of asphyxia can be evaluated by measuring the acid-base parameters in the blood. These parameters are as follows: pH, pCO_2, pO_2, base excess (BE: directly expressing the quantity of base /minus/ or acid /plus/ required restore the acid-base balance), actual bicarbonate (HCO_3: the titratable hydrogen carbonate content of whole blood) (Szenci and Nyirő, 1981).

A field study was performed in a large-scale Hungarian dairy herd (Dutch Friesian/Holstein Friesian crosses) where perinatal mortality ranged previously between 7.4% and 8.6% (Szenci et al., 1988). Delivery of 58 calves, all in normal anterior presentation, was uncomplicated; 3–4 attendants assisted with traction and delivery was completed within 30 minutes after the appearance and rupture of foetal membranes. The duration of traction was measured. In another study Caesarean sections of 44 black and white and red and white Dutch Friesian cows were performed within 4 to 5 hours after spontaneous rupture of foetal membranes in each case (Szenci and Taverne, 1988).

Foetal blood samples were collected by puncturing the *v. metacarpalis volaris superficialis* before the onset of traction and by puncturing *a. or v. umbilicalis* before the onset of extraction during Caesarean section.

Before and after birth, calves were assigned according their pH values to one of three groups as suggested by Eigenmann et al. (1981):

Group 1 blood pH > 7.2 (normal /physiological acidosis/= slight, combined respiratory and metabolic acidosis)

Group 2: blood pH 7.2–7.0 (acidotic = moderate, combined respiratory and metabolic acidosis)

Group 3: blood pH < 7.0 (severely acidotic = severe, combined respiratory and metabolic acidosis)

Shortly before the onset of traction, 25 out of 58 calves, or 25.8%, had moderate or severe acidosis (Szenci et al. 1988). In case of Caesarean section, 16 of 44 calves, or 36.4% had moderate or severe acidosis before the onset of the extraction from the uterus (Szenci and Taverne, 1988). The death of 2 newborn calves that were seemingly normal before birth indicates that either forced traction lasted too long or another, non-diagnosed complication occurred, such as premature compression and/or rupture of the umbilical cord, or premature separation of the placenta (Szenci et al., 1988). In agreement with Eigenmann (1981) and Schuijt (1990) forced traction jeopardises the calf's survival. Of the 4 calves (acidotic) only 1 was alive after birth. The intra-uterine pH of the 3 other calves, which were stillborn was nearly 7.0. This intra-uterine acid-base changes before traction or Caesarean section may be explained by late detection of the first stage of labour or by placental and/or umbilical cord anomalies which are responsible for disturbance of the transplacental gas exchange during calving (Szenci et al., 1988).

On the other hand, Held et al. (1985), using prenatal base-excess as a criterion in a study of 217 calvings, found 57,6% of the calves normal (BE > –6.0 mmol/L), 24.9% acidotic (BE: – 6.0 and –12.9 mmol/L), and 17.5% severely acidotic (BE ≤ –13 mmol/L). Perinatal mortality measured 0%, 8% and 51% in these three groups, respectively. The calves were delivered either spontaneously or aided by moderate pulling or by Caesarean section. In grouping of our calves delivered by Caesarean section according to Held et al. (1985), a very similar result (normal: 59.1% and acidotic: 40.9%) could be detected, which indicates that both parameters (pH and/or BE) are suitable for grouping of newborn calves (Szenci and Taverne, 1988).

Close correlation was also reported between the duration of the dilatation stage and the number of severely acidotic calves (less than 2 hours: 0%, 2 to 4 hours: 19%, 4 to 7 hours: 44%) by Held (1983).

Eigenmann et al. (1981) clearly showed that the prognosis for calves with intra-uterine pH < 7.2 is very poor, even when they are delivered by Caesarean section; 56% of these calves died during the first week. Although our data are perhaps less dramatic – of the calves with a prenatal pH lower than 7.2, after traction 33% and after Caesarean section 12% died within two days – both studies strongly indicate that the intra-uterine oxygenation and acid-base balance of acidotic calves should be improved before further obstetrical interference takes place. If this can not be performed the obstetrician may be supported by prenatal acid-base analysis in choosing the type of assistance (traction or Caesarean section) since the latter can be a careful procedure for blood gas and acid-base status of the newborn calves (Massip, 1980a; Eigenmann et al., 1981; Szenci, 1985a,b).

According to these results it was revealed that besides disturbances of diaplacental circulation except of the abnormality of umbilical cord and foetal membranes it is the duration of expulsive period (Held, 1983), the way of assistance (Eigenmann, 1981; Eigenmann et al., 1981; Szenci, 1983 and 1985a,b) and the duration of traction (Szenci, 1983; Szenci 1985a; Szenci et al., 1988; Schuijt, 1992) which influences the acid-base balance of newborn calves. At the same time maximum and relative force of traction appeared to be very weakly correlated with the changes of blood gas and acid-base values in calves during extraction. The highest relative force of traction during uncomplicated extractions was 5.4 kg per kg birth weight (Schuijt, 1992). In the case of traction it is the duration of passage through the birth canal and within this period – the duration of the compression of the umbilical cord which may play a decisive role. Therefore in the case of a complicated calving, the mode of assistance should be chosen by taking into consideration the economic point of view, as well as the aim that acid-base balance of newborn calves should be disturbed as little as possible that asphyxia should be avoided. If it is not possible the adequate treatment of asphyxiated newborn calves must be solved (Eigenmann et al., 1983a; Szenci, 1985).

IN CONCLUSION

At present, in veterinary practice the main emphasis should be paid on the prevention of asphyxia of calves at birth, since instruments suitable for a reliable clearing of respiratory passages and for the maintenance of this state, and for artificial respiration of calves under practical conditions are not yet widely used. The most important breeding objectives are to reduce the number of calving assistance required. This is even more important, since calving assistance in itself may result in a shift of the calf's acid-base balance. In case of dystocia, the mode and time of calving assistance should be chosen with regard to profitability factors and in a manner which would allow the least possible shift of the calf's acid-base balance towards acidosis (Held, 1983; Szenci, 1983 and 1985a). Before applying traction, the measurements of the soft birth canal should always be considered when dilatation of the soft maternal passages is not sufficient they must be expanded non-surgically or surgically (episiotomia lateralis) and obstetric lubricants should be used to avoid tractions longer than 2 to 3 minutes (Szenci, 1985b) and rib and vertebral fractures due to excessive traction (Schuijt, 1990). If a prolonged traction is expected, Caesarean section should be carried out to save the calf and to prevent injuries to the maternal birth canal. Recent studies have shown that before making a decision as to the mode of calving assistance in an animal hospital, the results of acid-base balance measurements from blood samples should be considered. The routine use of complex treatment of calves born with severe asphyxia may reduce the postnatal calf losses (Szenci, 2003). In addition to an adequate therapy (Eigenmann et al., 1983a), particular attention in the case of calves with asphyxia should be paid to the ingestion of sufficient amounts of colostrum, since the lack of colostrum uptake is accompanied by an increased susceptibility to E. coli infections (Eigenmann et al., 1983b; Besser et al., 1990).

This work was partly supported by OMFB 0173/2006 research found.

REFERENCES

Anderson DC, Bellows RA. Some causes of neonatal and postnatal calf losses. J. Anim. Sci., 1967.26.941 (Abstr.).

Berglund B, Steinbock L, Elvander M. Causes of stillbirth and time of death in Swedish Holstein calves examined post mortem. Acta Vet Scand. 2003.44.111–120.

Besser TE, Szenci O, Gay CC. Decreased colostral immunoglobulin absorption in calves with postnatal respiratory acidosis. J. Am. Vet. Med. Assoc., 1990.196.1239–1243.

Dawes GS. Foetal and neonatal physiology. Year Book Medical Publishers, Chicago, 1968.

Dufty JH, Sloss V. Anoxia in the bovine foetus. Aust, Vet. J., 1977.53.262–267.

Eigenmann UJE, Grunert E, Born E. Untersuchunger über den Einfluss der Schnittentbindung auf den Säurenbasenhaushalt sowie die Plasmaglukosekonzentration neugeborener Kälbern. Dtsch. Tierärtzl. Wschr., 1981.88.433–437.

Eigenmann UJE. Der Einfluss geburtshilflicher Massnahmen auf die Lebensfähigkeit neugeborener Kälber. Der praktische Tierarzt, 1981.62.933–942.

Eigenmann UJE, Rüdiger B, Schoon HA, Grunert E. Natriumbikarbonat- und Glukosebehandlung bei der Asphyxie des Kalbes. Dtsch. Tierärtzl. Wschr., 1982. 89. 228–234.

Eigenmann UJE, Grunert E, Luetgebrune K. Die Asphyxie des Kalbes. Der praktische Tierarzt, 1983a.64.603–611.

Eigenmann UJE, Zaremba W, Luetgebrune K, Grunert E. Untersuchungen über die Kolostrumaufnahme und die Immunoglobulin absorption bei Kälbern mit und ohne Geburtsazidose. Berl. Münch. Tierärtzl. Wschr., 1983b.96.109–113.

Greene HJ. Incidents and causes of dairy calf mortality in Ireland. Vet. Infec. Dis. Org., 1979.525–533.

Grunert E, Held Th, Scheidegger A. Einfluss der Snittenbindung auf die Vitalität des Kalbes. Collegium Veterinarium, 1985.16.11–16.

Gustafsson H, Kornmatitsuk B, Königsson K, Kindahl H. Peripartum and early post partum in the cow – Physiology and pathology. Le Médecin Vétérinaire Du Québec, 2004.34. 64–65.

Hahnsdorf A. Die wichtigsten Todesursachen des Kalbes anhand der Sektionstatistik mit besonderer Berücksichtigung der pathologisch-anatomischen Veränderungen. Inaugural Dissertation, Giessen. 1967.

Held Th. Klinische und blutgasanalytische Untersuchungen bei kalbenden Rindern and deren Feten. Inaugural Dissertation, Hannover, 1983.

Held Th, Eigenmann UJE, Grunert E. Blutgasanalytische Untersuchungsbefunde bei bovinen Feten im Aufweitungsstadium der Geburt. Mh. Vet. Med., 1985.40.405–409.

Massip A. The relation between the type of delivery and the acid-base and plasma cortisol levels of the newborn calf. Br. Vet. J., 1980a.136.488–491.

Mee JF. Perinatal calf mortality – recent findings. Irish Vet. J., 1991. 44.80–85.

Meyer CL, Berger PJ, Koehler KJ. Interactions among factors affecting stillbirths in Holstein cattle in the United States. J Dairy Sci., 2000.83.2657–2663.

Schuijt G. Iatrogenic fractures of ribs and vertebrae during delivery in perinattaly dying calves: 235 cases (1978–1988). J. Am. Vet. Med. Assoc., 1990.197.1196–1202.

Schuijt G. Quantified recording of traction during 33 bovine deliveries. Influence of characteristics of traction on blood gas and acid-base values, and vitality of the calf. In: Schuijt G. Aspects of obstetrical perinatology in cattle. Thesis, Utrecht, 1992. pp.59–77.

Steinbock L, Näsholm A, Berglund B, Johansson K, Philipsson J. Genetic effects on stillbirth and calving difficulty in Swedish Holsteins at first and second calving. J Dairy Sci., 2003.86.2228–2235.

Szenci O, Tőrös I, Péterhegyi Cs. Occurrence of perinatal mortality in two large-scale cattle farm (In Hungarian). Magy Áo. Lapja 1981.36.182–185.

Szenci O, Nyírő K. Assessment of the parameters controlling the acid-base status of newborn calves. (A modification of the Van Slyke equation). Acta Vet. Hung. 1981. 29. 153–157.

Szenci O, B Kiss M. Perinatal calf losses in large cattle production units. Acta Vet. Hung., 1982.30.85–95.

Szenci O. Effects of type and intensity of assistance on acid-base balance of newborn calves. Acta Vet. Hung., 1983.31.73–79.

Szenci O. The acid-base balance of newborn calves. In: Sonderheft Tierhygiene-Information, Berlin, 1984, pp 84–113.

Szenci O. Influence of the mode and timing of assistance on the acid-base balance of dam and newborn calf. Acta Vet. Hung., 1985a.33.199–204.

Szenci O. Role of acid-base disturbances in perinatal mortality of calves (A summary of thesis). Acta Vet. Hung., 1985b.33.205–220.

Szenci O, Taverne MAM, Bakonyi S, Erdődi A. Comparison between pre- and postnatal acid-base status of calves and their perinatal mortality. The Veterinary Quarterly, 1988.10.140–144.

Szenci O, Taverne MAM. Perinatal blood gas and acid-base status of Caesarean-derived calves. J. Vet. Med. A., 1988.35.572–577.

Szenci O. Role of acid-base disturbances in perinatal mortality of calves: review. Veterinary Bulletin, 2003.73.7R–14R.

Voelker HH. Calf mortality by breeds, sexes, breeding and years. J. Dairy Sci., 1967.50.993 (Abstr.).

Walser K, Maurer-Schweizer H. Die Asphyxia der Neugeborenen. Tierärztl. Prax., 1978.6.451–459.