

# Resuscitation of the newborn calf

Geof W. Smith, DVM, PhD, Dipl. ACVIM  
Zoetis, Raleigh, NC 27606

## Abstract

A significant number of calves still die before or shortly after calving. Dystocia is a major risk factor and both veterinarians and producers need to be aware of how to identify signs of distress in newborn calves and how to help provide effective resuscitation. The main objectives are to 1) get the calf breathing; 2) support circulation; 3) make sure the calf is warm and 4) provide pain relief. This presentation will focus on how to identify a calf that needs extra attention following birth and how to effectively triage calves and provide effective treatment to those that are good candidates for resuscitation.

**Key words:** dystocia, ventilation, resuscitation, calves, newborn, neonatology

## Assessing the newborn calf

The transition from life inside the uterus to an independent existence begins with the initiation of breathing which involves aeration of the lungs and subsequent oxygenation of the blood.<sup>1</sup> Immediately following birth, there should be an assessment of the calf to determine whether or not resuscitation is necessary. Calves without a heartbeat are likely poor candidates for recovery. However, calves that aren't breathing but do have a heartbeat are good candidates for resuscitation but require immediate attention. A newborn calf should have a heart rate between 90-160 beats/minute and a respiratory rate of 50-75 breaths/min. Producers can be trained to be aware of what "normal" signs of calf vigor are. In general, the calf should be able to lift its head within 2-3 minutes after birth, should be able to attain sternal recumbency within 5 minutes, the calf should be trying to stand within 20 minutes and should be fully standing within an hour after delivery. Within 2 hours the calf should be trying to nurse. Signs of calf distress can include a prolonged time to sternal recumbency, irregular respiratory rate, meconium staining, cyanotic mucous membranes, hemorrhages of the sclera or conjunctiva along with a swollen head or tongue.

In human neonatology, newborn infants are commonly assessed with an APGAR scoring system that evaluates 1) color, 2) heart rate, 3) reflexes, 4) muscle tone, and 5) respiration, each of which is given a score of 0, 1 or 2. A similar system has been developed for calves termed the VIGOR score that producers can use to determine which calves are showing signs of distress and need extra attention.<sup>2,3</sup> There is even an app for the iPad from the University of Wisconsin (Calf VIGOR Scorer) for producers available in multiple languages. In my experience, people will seldom use calf vigor scoring systems on every animal. However, if they learn to use these systems, they get better at recognizing the signs of distress in a newborn calf.

## Immediately after birth

As soon as possible after the calf is delivered, it should be placed into sternal recumbency. This is the best position for the calf to expand both of its lungs.<sup>4</sup> Some folks like to hang calves upside down or "helicopter" them around by their rear legs. In general, this isn't a good idea. Calves need to overcome a significant pressure gradient to expand their lungs and they can't

do this while upside down. You can occasionally see fluid come out of calves when you hang them upside down, but realize this fluid is coming from the abomasum – not the lungs. You can hear fluid rattle around in the lungs of newborn calves – but this fluid is in interstitial spaces – not just sitting in trachea or bronchi where it can be drained by gravity. So, get the calf sternal as soon as possible. Hanging it upside down for 30 seconds probably doesn't hurt anything, but this should not be done for prolonged periods of time.<sup>5</sup> In Belgian Blue calves delivered via C-section, putting them in sternal recumbency immediately after umbilical cord rupture had a positive functional impact on postnatal pulmonary mechanics and gas exchange and on postnatal correction of mixed acidosis present at birth as compared to leaving calves on their side (lateral recumbency).<sup>5</sup> Once the calf is sitting up, we can stimulate it to breathe by rubbing it with hands, towels and/or sticking a finger or piece of straw in the nose. The rupture of the umbilical cord and subsequent rise in pCO<sub>2</sub> should initiate the calf to start breathing in 20-30 seconds. If the calf doesn't begin breathing, it's time to get more aggressive.

## Respiration

After the umbilical cord ruptures, dropping oxygen and increasing carbon dioxide levels along with acidemia stimulate the beginning of spontaneous breathing.<sup>6</sup> If the calf doesn't start breathing immediately after birth, the consequence is often death. Therefore, the primary objective in "resuscitation" of the calf is typically to support respiration and attempt to get it breathing. Various techniques to encourage respiration have been described including:

### Acupuncture

There is a spot on the tip of the nose called the Jen Chung acupuncture point. It has been used by multiple veterinarians to stimulate breathing in apneic calves with decent results. I usually recommend taking an 18- or 20-gauge needle and sticking it as far as it will go right into the philtrum (midline) of the nose. This should stimulate the central nervous system, increasing both heart and respiratory rates. A study in sheep showed the technique was effective in reversing respiratory arrest.<sup>7</sup>

### Caffeine

For many years, caffeine has been used to stimulate breathing in premature infants.<sup>8</sup> It works by antagonizing the suppressive effects of adenosine. Inflammation causes adenosine levels to rise which has a depressive effect on the respiratory system. Caffeine stimulates adenosine clearance thus having a positive effect on respiratory rate, tidal volume and pulmonary blood flow.<sup>8</sup> Anecdotally, veterinarians and producers have used caffeine in newborn calves having trouble breathing with some success. Years ago, NoDoz caffeine pills were recommended, but more frequently liquid caffeine supplements like 5-Hour ENERGY® have been utilized. More research is needed to understand how effectively caffeine stimulates respiration in newborn calves and exactly how much is needed. However, in a model of respiratory acidosis in foals, caffeine was no better than saline in stimulating ventilation.<sup>9</sup>

---

## Ice water

Another technique to stimulate respiration that is commonly used but lacks much research is pouring ice water over the calf's head. You can either pour 1-2 quarts of ice water over the calf's head or squirt 60 ml of ice water directly into their ear. In theory this stimulates the diving reflex which redirects blood flow to the heart and lungs.<sup>10</sup> In one study, calves that had 5 liters of cold water dumped over their heads immediately after birth resulted in a slight improvement in pulmonary gas exchange as compared to doing nothing.<sup>5</sup>

## Doxapram

If all other techniques fail, doxapram is an analeptic agent that can be given to stimulate peripheral chemoreceptors and medullary respiratory neurons. An analeptic agent is defined as a drug that stimulates depressed respiratory and cardiovascular centers. Although not commonly present on the truck of most bovine practitioners, doxapram at 2 mg/kg IV has a potent stimulating action on the respiratory center. Veterinarians working with high risk (i.e. IVF) calves certainly could keep some doxapram around if needed to get calves breathing. Doxapram may also have some benefit in stimulating respiration in calves that have respiratory depression caused by drugs, particularly from xylazine given to the cow during calving.<sup>11,12</sup> It is unlikely to have a positive effect in calves with profound central nervous system depression secondary to hypercapnia. These animals are likely to require ventilatory support.

## Mechanical ventilation

When attempts to get the calf breathing fail, mechanical ventilation may be the last resort to try to save the calf (particularly if it still has a heartbeat). Positive pressure ventilation is the only means of overcoming the surface tension of alveoli and elastic recoil in the lung tissue to aerate lungs.<sup>13</sup> Mouth-to-mouth or mouth-to-nose breathing or face masks would be one type of positive pressure ventilation, but may not be that effective. The McCulloch calf respirator can be purchased for about \$125 (Nasco) and can effectively ventilate a calf. This consists of a mask that fits over the mouth and nose and pushes air into oro-nasal cavity through a bi-directional valve that allows the calf to exhale without removing the mask from its face. The disadvantage (particularly with long-term use) is that it will force air into the esophagus and does not protect the trachea from aspiration. The use of a cuffed endotracheal tube would be ideal, however, this is not easy to accomplish in the field. A recent paper investigated the use of a laryngeal mask airway (LMA) in calves, commonly used by human emergency medical technicians to support breathing.<sup>13</sup> The authors used anesthetized Holstein calves where hypoventilation was induced with alfaxalone and found that the LMA was an effective means of ventilation neonatal calves. In this study they found that the iGel® model of LMA was relatively easy to place in calves, however, the seal around the larynx was inadequate, whereas the Solus Flexible® device was difficult to place without a stylet. The authors of the study found that the Solus model was the most effective and a size 4 was optimal for most calves (a size 3 might be needed for smaller calves).

## Respiratory acidosis

Often, premature calves are unable to breath normally, regulate body temperature and suckle because the corresponding centers in the brain are not fully developed. Therefore, these calves may frequently be born severely acidotic or a respiratory acidosis can develop quickly. Healthy calves will start breathing within a few seconds. Although breathing might be erratic initially, it will settle down to 50 breaths/minute or so pretty quickly. Calves that have an irregular or accelerated respiratory rate for longer than 30 minutes may have a severe respiratory acidosis. Although it's not easy to do a blood gas analysis in the field, prolonged erratic breathing, poor muscle tone and/or absent pedal reflex, cyanotic mucous membranes, and/or neurologic signs may suggest the presence of hypoxia and respiratory acidosis. Sodium bicarbonate has been used empirically at 1-2 mEq HCO<sub>3</sub> per kg IV to resuscitate calves after a dystocia with no reported adverse effects. This is equivalent to about 50 ml of hypertonic (8.4%) sodium bicarbonate given fairly slowly IV.

## Warm the calf up

Warming a cold calf can also help stimulate breathing and circulation. In one study, placing newborn calves under infrared radiant heat changed the breathing pattern corresponding to a better distribution of ventilation and improved gas exchange.<sup>5</sup> In extremely hypothermic calves, placing them in a hot water bath (~100° F) has been shown to be the quickest way to increase body temperatures (unpublished data, Joe Smith, University of Tennessee).

## Pain management

For a long time, veterinarians have recognized that dystocia is painful for the cow. We commonly treat cows after a hard pull with corticosteroids and/or NSAIDs to limit inflammation and provide analgesia. However, we do a relatively poor job of recognizing that dystocia is also likely painful for the calf. A recent study from Japan examined 101 newborn calves and found that almost 20% of calves born via an assisted delivery had evidence of rib fractures, most commonly in the 4th thru 7th ribs.<sup>14</sup> The authors concluded these fractures were almost certainly from the excessive traction used to extract calves with either human or mechanical (ie. calf jack) intervention. Calves with difficult deliveries almost certainly have muscle bruising and other injuries that may cause pain. Therefore, we should probably consider the routine use of an NSAID in calves born with assisted deliveries. A Canadian study looked at 842 calvings and assigned each calf a VIGOR score at birth.<sup>2</sup> Some calves received meloxicam (1.0 mg/kg, SC) while others received a placebo. Low vitality calves that were treated with meloxicam had improved weight gain in the first week and better health scores over the first 6 weeks of life as compared to calves that did not receive meloxicam. In another study, 98 calves born via normal vaginal delivery were compared to 82 dystocia-delivered calves.<sup>15</sup> Half of the calves in each group were given meloxicam after birth. Newborn calf vitality and several parameters associated with lying behavior were monitored. Meloxicam had no effect on any of the measurements in normal calves, however it significantly increased time spent standing and average duration of standing in those calves born from dams that had dystocia. The authors concluded that a single dose of an NSAID showed considerable promise in helping low-vitality calves. In conclusion, pain is a reality in many calves born via assisted deliveries and the use of an NSAID for analgesia should be considered part of the resuscitation protocol.

In conclusion, veterinarians should work with cattle producers and make sure they understand what a “normal” calf looks and acts like after birth and what signs would constitute a stressed calf that needs extra attention. Making sure they understand how to properly stimulate breathing is probably the most important thing to focus on. With some education, farms can work to significantly reduce the calf mortality that happens during the first 1-2 hours of life.

## References

1. Grove-White D. Resuscitation of the newborn calf. *In Pract* 2000;22:17-23.
2. Murray C, Haley DB, Duffield TF, Pearl DL, Deelen SM, Leslie KE. A field study to evaluate the effects of meloxicam NSAID therapy and calving assistance on newborn calf vigor, improvement of health and growth in pre-weaned Holstein calves. *Bov Pract* 2015;49:1-12.
3. Murray, C, Leslie K. Newborn calf vitality: Risk factors, characteristics, assessment, resulting outcomes and strategies for improvement. *Vet J* 2013;198:322-328.
4. Uystepuyst C, Coghe J, Dorts T, Harmegnies N, Delsemme MH, Art T, Lekeux P. Sternal recumbency or suspension by the hind legs immediately after delivery improves respiratory and metabolic adaptation to extra uterine life in newborn calves delivered by caesarean section. *Vet Res* 2002;33:709-724.
5. Uystepuyst CH, Coghe J, Dorts TH, Harmegnies N, Delsemme MH, Art T, Lekeux P. Effect of three resuscitation procedures on respiratory and metabolic adaptation to extra uterine life in newborn calves. *Vet J* 2002;163:30-44.
6. Kasari T. Physiologic mechanisms of adaptation in the fetal calf at birth. *Vet Clin North Am Food Anim Pract* 1994;10:127-136.
7. Davies A, Janse J, Reynolds GW. Acupuncture in the relief of respiratory arrest. *NZ Vet J* 1984;32:109-110.
8. Dekker J, Hooper SB, van Vonderen JJ, Witlox RS, Lopriore E, te Pas AB. Caffeine to improve breathing effort of preterm infants at birth: a randomized controlled trial. *Pediatr Res* 2017;82:290-296.
9. Giguère S, Sanchez LC, Shih A, Szabo NJ, Womble AY, Robertson SA. Comparison of the effects of caffeine and doxapram on respiratory and cardiovascular function in foals with induced respiratory acidosis. *Am J Vet Res* 2007;68:1407-1416.
10. Foster GE, Sheel AW. The human diving response, its function, and its control. *Scand J Med Sci Sports* 2005;15:3-12.
11. Nagy DW. Resuscitation and critical care of neonatal calves. *Vet Clin North Am Food Anim Pract* 2009;25:1-11.
12. Holenweger Dendi JA, Parada HL. Analeptic effect of doxapram after Rompun treatment in cattle. *Vet Med Rev* 1981;1:70-74.
13. Armstrong L, Caulkett N, Pearson JM, Knight CG, Windeyer MC. Assessing the efficacy of ventilation of anesthetized neonatal calves using a laryngeal mask airway or mask resuscitator. *Front Vet Sci* 2018;5:292. doi:10.3389/fvets.2018.00292.
14. Ono M, Sugita T, Ishikawa C, Sumiyoshi T, Horikita T. Incidence and etiology of rib fracture in live neonatal calves. *J Jpn Vet Med Assoc* 2021;74:181-185.
15. Kovács L, Kézer FL, Ruff F, Samardzija M, Szenci O. Single-dose meloxicam treatment improves standing ability of low-vitality dairy calves. *J Dairy Sci* 2022;105:1618-1624.

