PEER REVIEWED

Efficacy of a New Navel Dip to Prevent Umbilical Infection in Dairy Calves

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Abstract

A field study was conducted utilizing 495 newborn calves in 13 commercial Wisconsin dairy herds to evaluate the use of a new umbilical disinfectant dip (Navel Guard (NG), Sirius Chemical Group, McDonough, GA) to prevent umbilical infections (omphalitis) as compared to control groups (CG): 1) not dipping the umbilicus at birth (CG_{Nodip}; trial conducted in two herds), 2) dipping the umbilicus with 7% tincture of iodine (CG_{7TI}; trial conducted in seven herds), or 3) dipping with solutions containing a low concentration (0.5 to 2%) of iodine (CG_{ILow}; trial conducted in four herds).

In all three trials, newborn calves were alternately assigned (every other calf) to have their navel dipped with either NG or the control article (CG_{Nodip}, CG_{7TI} or CG_{ILow}) as soon as possible after birth. A study technician evaluated each calf's navel once per week for the first three weeks of life by measuring the diameter of the umbilical stalk and determining whether a painful response was elicited upon palpation of the umbilicus.

Results indicate that Navel Guard was more effective for reducing the incidence of umbilical infections in neonatal calves compared to calves not dipped shortly after birth. The risk for umbilical infection was numerically, but not statistically, reduced in calves when the umbilicus was dipped with Navel Guard as compared to calves for which the umbilicus was dipped with 7% tincture of iodine or solutions containing low concentrations of iodine (0.5 to 2.0%).

Keywords: bovine, calf, neonate, navel dip, umbilicus, omphalitis

Résumé

Une étude sur le terrain a été menée avec 495 veaux nouveau-nés dans 13 troupeaux laitiers commerciaux du Wisconsin afin d'évaluer l'utilisation d'une nouvelle solution de trempage de l'ombilic (Navel Guard (NG), Sirius Chemical Group, McDonough, GA) pour prévenir les infections de l'ombilic (omphalites) par rapport aux situations suivantes : 1) aucun trempage de l'ombilic à la naissance (un essai dans deux troupeaux), 2) trempage de l'ombilic avec une solution de teinture d'iode à 7% (un essai dans sept troupeaux) ou 3) trempage avec une solution contenant une faible concentration d'iode (0.5 à 2%) (un essai dans quatre troupeaux).

Dans les trois essais, les veaux nouveau-nés ont été alloués alternativement (un veau sur deux) au traitement avec la solution NG ou à l'un des trois groupes témoins le plus tôt possible après la naissance. Un technicien de l'étude a examiné le nombril de chaque veau une fois par semaine pendant les trois premières semaines suivant la naissance pour mesurer le diamètre du reste du cordon ombilical et déterminer si la palpation de l'ombilic causait de la douleur.

Les résultats montrent que l'incidence des infections de l'ombilic chez les veaux nouveau-nés était moindre dans le groupe avec trempage avec la solution NG que dans les groupes sans trempage avec cette solution peu après la naissance. Le risque d'infection de l'ombilic était numériquement moindre mais pas statistiquement moindre chez les veaux recevant la solution NG que chez les veaux dont l'ombilic était trempé avec la solution de teinture d'iode à 7% ou celle contenant une faible concentration d'iode (0.5 à 2%).

Introduction

The umbilical cord contains two umbilical arteries, the umbilical vein, and the urachus.[21] Rupture of the umbilical cord during the birthing process leaves the end of the cord and its internal structures open to potential contamination by pathogens present in the maternity pen or other calf housing areas. Without contamination, these structures atrophy and become vestiges. Atrophy of the umbilical structures inside the abdominal cavity that comprise the umbilical cord has been described by ultrasonography,[16,29] as has normal atrophy of the portion of the umbilical stalk exterior to the abdomen and under the skin.[29] The normal drying time for the portion of the cord exterior to the skin has also been described.[13]

For the remainder of this article, the umbilical stalk will refer to the remnant of the umbilical cord that is subcutaneous but exterior to the abdominal body wall and available for palpation. If contamination of the umbilical stalk occurs, umbilical infection can occur, with swelling, pain, and/or purulent discharge from the umbilical stalk. Many calves with palpable infections of the umbilical stalk also have other internal lesions.[2,4,11,18,19,21] The incidence of umbilical infections in dairy calves has been reported to be between 1% and 14%,[2,4,6,7,21,23,24,25,26] but most references do not explain the method of examination or give a clear case definition of an infected umbilicus. The occurrence of umbilical infection and its sequela has been associated with failure of passive transfer (FPT) and abnormal metabolic status, as well as with other neonatal diseases.[7,18,20] Umbilical infections should be of concern to dairy producers because, in addition to the costs of treatment (labor, medicine, veterinary care), they have been associated with an increased incidence of umbilical hernia, other neonatal diseases, mortality, reduced growth rates, and decreased herd survivorship.[1,3,19,21,22,25,26]

Common recommendations for preventing umbilical infections include maintaining a clean, dry maternity pen environment, excellent colostrum management, and dipping navels with a disinfectant solution soon after birth.[9,10,12,14,18,19] However, prior investigations, most of them observational studies, have drawn different conclusions about the relationship between navel dipping at birth and the incidence of umbilical infections or production parameters.[3,8,17] Some authors have doubted the efficacy of dipping navels,[15,18,19,27,28] while others have recommended it as a routine management practice.[9,10,12,14,18] Controlled clinical trials to investigate dipping navels with a disinfectant solution soon after birth to reduce risk of umbilical infections have been lacking.

For decades, 7% tincture of iodine (7TI) has been widely used as a neonatal navel dip. However, in July 2007 the Drug Enforcement Agency (DEA) placed severe restrictions on the distribution of 7TI because of its illegal use as an ingredient in the manufacturing of recreational methamphetamine.[5] As a result, the use of other products as a navel dip has become common, but none have been evaluated for efficacy.

Navel Guard (NG)[a] is a new, commercially available umbilical dip. The active ingredients are a proprietary ingredient with antimicrobial properties and isopropyl alcohol, which is included to speed drying of the umbilical cord. A food color has been added to facilitate identification of calves that have been treated. The antimicrobial activity of the proprietary ingredient in NG has been validated by a FDA certified laboratory[b] utilizing standardized USP protocols.[c]

The objective of this study was to compare the effectiveness of Navel Guard to control groups (CG): 1) not dipping the umbilicus at birth (CG_{Nodip}), 2) dipping the umbilicus with 7% tincture of iodine (CG_{7TI}), or 3) dipping the umbilicus with solutions containing a low concentration (0.5 to 2%) of iodine (CG_{ILow}) for prevention of umbilical infections.

Materials and Methods

Participating Dairies

Twenty predominately Holstein dairies in southeastern Wisconsin in close proximity to the principal investigator (WG) were invited to participate. Fifteen dairies representing a total of 4,850 milking cows accepted the invitation. In order to participate, owners/managers of the convenience sample of herds agreed to follow study protocols and to keep necessary records of treatment assignment. Participating dairies received no compensation except free test product (NG), two navel dippers,[d] and surgical scissors in a disinfectant storage container. Ear tags and a matching tag applicator were provided to those dairies that did not routinely tag bull calves they retained. Producers were also invited to attend a calf management seminar at the end of the trial.

The 15 participating dairies ranged in size from 70 to 1,150 cows, and all utilized free-stall housing and a milking parlor. There was a wide variety of calving facilities. All calves were housed individually for the duration of the trial, but in diverse housing arrangements ranging from calf hutches of various design to calf barns that varied from new facilities to retrofits of older buildings.

Calf Inclusion Criteria

All live-born calves were eligible for inclusion in the study, provided they would be available for three weekly evaluations (to three weeks of age) following enrollment at birth. Twelve dairies raised heifer calves at the home site, while three dairies raised their heifers at a custom grower on one single location where they were available for follow-up during the study. Four of the dairies raised their own bull calves at the home site, while five other dairies sold their bulls to one individual where they were available for follow-up. Bull calves from the six remaining dairies were not enrolled, as they were sold shortly after birth and not available for follow-up.

Calf Enrollment Procedure

Calves were enrolled between February and April, 2010. On each farm, newborn calves eligible for inclusion in the study were systematically assigned (every other calf born) to a treated group (NG) or a control group. The control group (CG) for any given farm was defined as the routine navel dipping practice used on that farm prior to starting the study. Prior to initiating the study, four farms routinely did not dip navels (CG_{Nodip}),

seven farms routinely dipped navels using 7% tincture of iodine (CG_{7TI}), and four farms routinely dipped navels using a less concentrated iodine solution ranging between 0.5 to 2% (CG_{ILow}). Soon after birth, each calf was ear tagged, had its umbilicus dipped with the assigned treatment article (NG or CG), and its treatment recorded.

Dipping Technique

Producers dipped the calves' navels immediately after birth, or as soon as the calf was discovered for unobserved births. Long umbilical cords were cut off with disinfected surgical scissors about 1.5 inches (40 mm) exterior to the skin. The umbilical cord remnant was then dipped by submerging the entire cord in 15 mL of navel dip contained in the cup of a non-return type teat dipper[d] and swirling vigorously. Fresh dip was used for each calf and excess dip was discarded after each use. One dairy dipped navels a second time six to 12 hours later. Navels of calves in the CG_{Nodip} group did not have their navels clipped or dipped, even with an empty dipper.

Evaluation of Calves for Umbilical Infection

During the first two weeks of the study, all weekly evaluations were performed by the principal investigator (WG) while training a study technician (ST) to do the evaluations. All subsequent evaluations were performed by the ST, who was monitored in the fourth and eighth week of the trial by WG.

Each farm was visited once per week on the same day of the week. Enrolled calves were evaluated once per week for the first three weeks of life. On the first visit to each farm, the records in the maternity area were first accessed to determine which calves were newly enrolled in the previous seven days and to record the treatment they had received. Prior to all subsequent visits, the ST would prepare a list of calves due for their second and/or third examination. On arrival at the farm, the ST would go to the calf housing area and do the second and third week evaluations for previously enrolled calves, and would then examine the umbilical stalks of all calves with higher ear tag numbers, which represented calves born since the previous farm visit. The ST would then go to the maternity area to access treatment records, thereby attempting to ensure the ST was blinded to treatment group at the time of evaluation.

Evaluation criteria were 1) "yes" or "no" to a pain response and 2) the diameter of the umbilical stalk adjacent to and about 1 inch (25 mm) from the abdominal wall. To assess a pain response, a ventral approach to the abdominal wall was used with the tips of the thumb and fingers touching the abdominal wall, placing the umbilical stalk between the thumb and first two fingers of the ST. A firm squeeze was applied to the umbilical stalk and the calf was observed for a flinch as a pain response.

The diameter of the umbilical stalk was determined by rolling the stalk between the thumb and first two fingers on one hand, and comparing the diameter of the stalk to a selection of wooden dowels in the other hand. Dowels were in 1/16th inch (1.59 mm) increments from 3/16ths inch (4.77 mm) to 1/2 inch (12.7mm) and in 1/8th inch (3.18 mm) increments to 3/4ths inch (19.05 mm), so the umbilical stalk diameter was recorded as 3, 4, 5, 6, 7, 8, 10, 12, or >12/16ths of an inch (Image 1).

The umbilicus was considered infected if it met any one of the following four criteria: 1) the calf demonstrated a pain response at any of the three weekly evaluations, 2) the umbilical stalk did not atrophy and was still 8/16ths of an inch (12.7 mm) or larger on the third evaluation, 3) the umbilical stalk did atrophy but

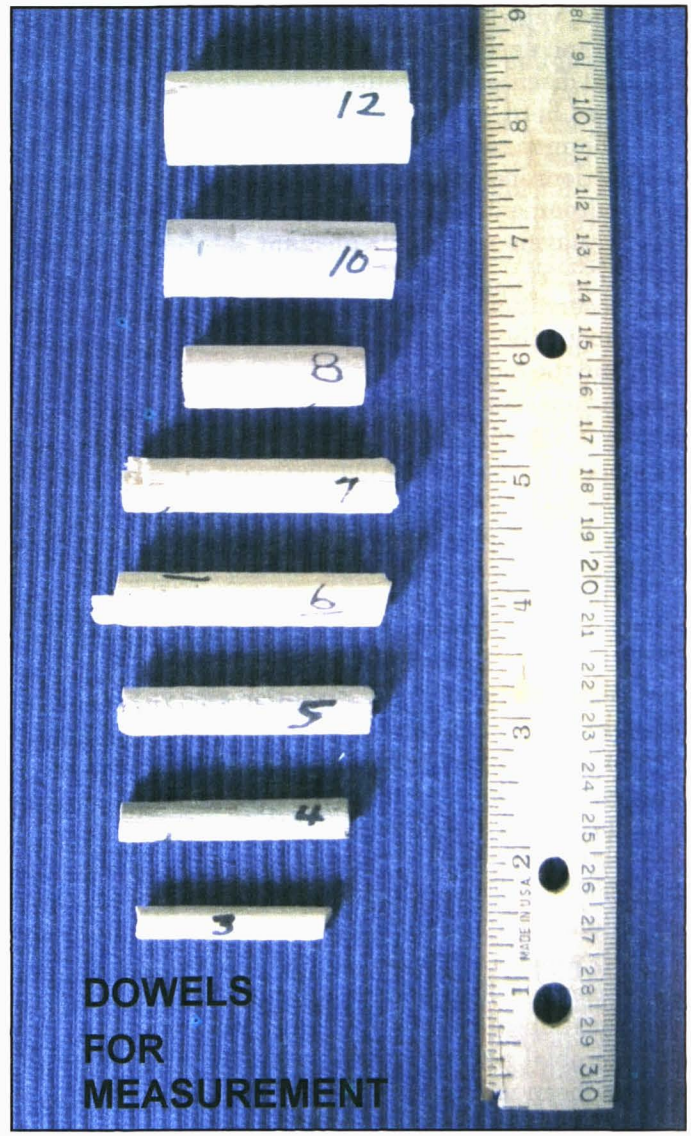

Image 1. Picture of dowels used to measure diameter of the umbilical stalk in study calves.

was still 10/16ths of an inch (15.9 mm) or larger on the third evaluation, or 4) the diameter of the umbilical stalk increased in size as compared to a prior evaluation of <8/16ths of an inch (12.7 mm).

Statistical Analysis

Data collected by the ST during farm visits was transferred to an Excel spreadsheet (Microsoft Corp.), and then analyzed using SAS (version 9.2; SAS Institute, Cary, NC). Because two of the four study herds in Trial 1 enrolled very few animals into the study (≤5 calves per herd), data from these two herds were omitted from the final analysis due to concerns about inconsistent adherence to study enrollment protocols. As such, data from 13 herds was used for the final analysis.

Because different herds had different CG (Trial 1 – two herds = CG_{Nodip}; Trial 2 – seven herds = CG_{7TI}; Trial 3 – four herds = CG_{ILow}), and because preliminary analysis showed the presence of an interaction between the estimated effect of treatment with NG and a variable describing the type of CG used (CG_{Nodip}, CG_{7TI} or CG_{ILow}), the data were subsequently stratified by trial, and analyzed in three separate analyses (i.e. NG versus CG_{Nodip}; NG versus CG_{7TI}; NG versus CG_{ILow}).

For analysis of each of the three trials, descriptive statistics were first generated to describe, for each treatment group, the number of calves enrolled, the average age at each of the three weekly evaluations, the average umbilical stalk diameter at each of the three weekly evaluations, the proportion of calves that demonstrated a positive pain response, and the proportion of calves classified as having an umbilical infection sometime during the first three weeks of life. Multivariate logistic regression (Proc GENMOD in SAS) was then used to describe the relationship between treatment group (NG vs CG_{Nodip}; NG vs CG_{7TI}; NG vs CG_{ILow}; forced explanatory variable) and risk for developing an umbilical infection (Yes/No; dependent variable). Herd was forced into all models as a fixed effect to control for the clustering of calves within herd. Final significance was declared at $P < 0.05$.

Results

A total of 550 calves from 13 herds were initially enrolled into the study. However, a total of 55 (10%) of these records were omitted from the final analysis for the following reasons: 1) treatment group not recorded (n = 5), 2) missing or suspect records (n = 13), 3) incomplete records because the calf died (n = 18), was sold (n = 7) or disappeared (n = 11) before it completed the study, or 4) because hernia repair impeded evaluation (n = 1). In the end, 495 records from 13 herds were available for the final analysis.

The authors recognize that some of these record omissions, especially those attributed to death, sale, disappearance, or hernia repair, may have been associated with the outcome of interest (umbilical infection), and therefore could potentially introduce an underreporting bias across the entire study. There is nothing the authors can do about this concern except to acknowledge this possibility and note that omissions were limited to 10% of all records. A more important concern related to the question of, if an underreporting bias did exist, whether it was unequally distributed across treatment groups, thereby potentially biasing study inferences. Calculations showed the proportion of calf records omitted from analysis to be 10.8%, 7.6%, 16.3%, and 10.2% for calves originally enrolled into the NG, CG_{7TI}, CG_{ILow}, and CG_{Nodip} treatment groups, respectively. There were no obvious imbalances in omitted records, between treatment groups, within any one farm. Because these record omission rates were reasonably consistent across all treatment groups and within each farm, the authors are comfortable that these omissions should not introduce an important bias when making comparisons between the various treatments under study.

Of the 495 records used for the final analyses in all three trials, 14% (70 of 495) of all calves experienced an umbilical infection during the first three weeks of life. For all calves not diagnosed as having an umbilical infection, the mean (SD; range) umbilical stalk diameter at the first, second and third evaluation was 13.3 (2.9; 6.4 to 19.1), 9.8 (3.0, 4.8 to 19.1), and 7.9 (2.2, 4.8 to 12.7) mm, respectively. For all calves diagnosed with an umbilical infection, the mean (SD; range) umbilical stalk diameter at the first, second and third evaluation was 16.5 (2.9; 7.9 to 19.1), 15.3 (3.4; 7.9 to 19.1), and 14.7 (3.7; 6.4 to 19.1) mm, respectively. Forty-three percent (30 of 70) of all calves with umbilical infections demonstrated a positive pain response. For these calves, the median (mean, SD, range) days to a positive pain response was 4.0 (6.6; 5.6; 1 to 22) days.

Table 1 describes the number of calves enrolled in each trial and each treatment group, the average age (days), and average umbilical stalk diameter (mm) at each of the three weekly evaluations, the proportion of calves that demonstrated a positive pain response, and the proportion of calves classified as having an umbilical infection sometime during the first three weeks of life.

Trial 1 - Navel Guard versus No Dip Comparison. A total of 58 (NG) or 53 (CG_{Nodip}) calves from two herds were dipped with NG or not dipped, respectively, at birth. The proportion of calves experiencing a navel infection were 10.3% (6 of 58) and 28.3% (15 of 53) for calves enrolled in the NG and CG_{Nodip} groups, respectively. The odds of developing an umbilical infection were estimated to be 3.48 (95% CL: 1.23, 9.86) times greater in calves for which the umbilicus was not dipped as compared to calves dipped with NG ($P = 0.014$; Figure 1).

Table 1. Description of calves treated with various navel dips shortly after birth.

Treatments compared	Treatment group	
Trial 1. Navel Guard vs No Dip	Navel Guard	No Dip
Number of herds	2	2
Number of calves	58	53
Age at evaluation (mean (SD), days)		
Week 1	4.2 (2.2)	4.6 (2.1)
Week 2	11.2 (2.2)	11.7 (2.1)
Week 3	18.2 (2.2)	18.7 (2.1)
Umbilicus diameter (mean (SD), mm)		
Week 1	14.0 (3.0)	14.6 (3.15)
Week 2	10.7 (3.93)	11.3 (3.96)
Week 3	8.7 (3.50)	9.3 (3.54)
Calves with pain response (n, %)	3 (5.2%)	8 (15.1%)
Calves with umbilical infection (n, %)	6 (10.3%)	15 (28.3%)
Trial 2. Navel Guard vs 7% Tincture of Iodine	Navel Guard	7% Tincture of Iodine
Number of herds	7	7
Number of calves	147	146
Age at evaluation (mean (SD), days)		
Week 1	4.8 (2.4)	4.7 (2.1)
Week 2	11.7 (2.4)	11.7 (2.1)
Week 3	18.7 (2.4)	18.7 (2.1)
Umbilicus diameter (mean (SD), mm)		
Week 1	13.4 (2.93)	13.9 (3.05)
Week 2	10.2 (3.45)	10.8 (3.50)
Week 3	8.6 (3.44)	8.9 (3.43)
Calves with pain response (n, %)	7 (4.8%)	8 (5.5%)
Calves with umbilical infection (n, %)	16 (10.9%)	24 (16.4%)
Trial 3. Navel Guard vs 0.5-2% Iodine	Navel Guard	0.5 to 2% Iodine
Number of herds	4	4
Number of calves	50	41
Age at evaluation (mean (SD), days)		
Week 1	4.3 (2.5)	4.0 (2.6)
Week 2	11.3 (2.5)	11.0 (2.6)
Week 3	18.3 (2.5)	18.0 (2.6)
Umbilicus diameter (mean (SD), mm)		
Week 1	13.6 (3.40)	13.8 (3.44)
Week 2	9.9 (3.30)	10.8 (3.81)
Week 3	8.4 (3.0)	9.60 (3.76)
Calves with pain response (n, %)	3 (6.0%)	1 (2.4%)
Calves with umbilical infection (n, %)	3 (6.0%)	6 (14.6%)

Trial 2 - Navel Guard versus 7% Tincture of Iodine Comparison. A total of 147 (NG) or 146 (CG_{7TI}) calves from seven herds were dipped with NG or 7% tincture of iodine, respectively, at birth. The proportion of calves experiencing a navel infection were 10.9% (16 of 147) and 16.4% (24 of 146) for calves enrolled in the NG and CG_{7TI} groups, respectively. Despite these numeric differences, the odds of developing an umbilical infection were not different for calves enrolled in the NG group (O.R. = 1.69 (0.83, 3.41)) as compared to calves enrolled in the CG_{7TI} group ($P = 0.14$; Figure 1).

Trial 3 - Navel Guard versus 0.5 to 2% Iodine Comparison. A total of 50 (NG) or 41 (CG_{ILow}) calves from four herds were dipped with NG or 0.5 to 2% iodine solutions, respectively, at birth. The proportion of calves experiencing a navel infection were 6.0% (3 of 50) and 14.6% (6 of 41) for calves enrolled in the NG and CG_{ILow} groups, respectively. Despite these numeric differences, the odds of developing an umbilical infection were not different for calves enrolled in the NG group (O.R. = 2.88 (0.60, 13.78) as compared to calves enrolled in the CG_{ILow} group ($P = 0.17$; Figure 1).

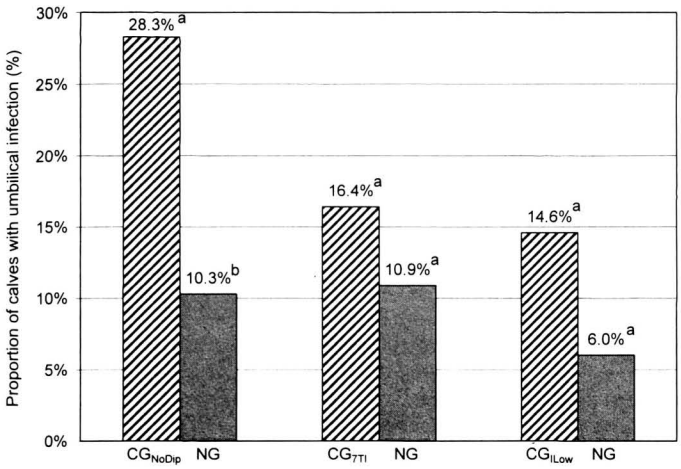

Figure 1. Proportion of calves diagnosed with umbilical infection in trials comparing calves dipped with Navel Guard (NG) as compared to control group (CG) calves dipped with nothing (CG_{Nodip} vs NG), 7% tincture of iodine (CG_{7TI} vs NG), or solutions containing low concentrations of iodine (0.5 to 2%) (CG_{ILow} vs NG). [a,b]Differences within trial significant at $P < 0.05$.

Discussion

Umbilical infections are perceived as a low-incidence, and probably a low-priority, disease by many livestock producers and veterinarians. Ignoring treatment group, 14% of all 495 calves enrolled in the current study were classified as having an umbilical infection. This is in agreement with previous studies that have reported the incidence of umbilical infections in dairy calves to be between 1% and 14%.[2,4,6,21,23,24,25,26] Many infections in the present trial might have gone undetected had the ST not examined every calf, as many dairy producers do not routinely evaluate neonatal calves for omphalitis.

While the practice of dipping navels with a disinfectant solution at birth is routinely recommended as one approach to help prevent umbilical infections, the authors could not find any controlled studies investigating the efficacy of the practice of navel dipping. In one observational study,[27,28] navel treatments had either a positive relationship or no relationship with risk for morbidity or mortality, respectively, with the exception of chlorhexidene, which had a negative (sparing) relationship with risk for mortality. However, readers should avoid making causal inferences from observational studies, as associations detected (or not detected) may be confounded by other unidentified factors. The authors could not find any studies that compared different techniques for dipping navels as a variable for preventing omphalitis, so the "clip and dip" procedure preferred by the senior author was selected. Non-dipped navels in the CG_{Nodip} treatment group were not clipped and dipped, as the senior author's opinion is that 1) omphalitis initiates at the broken, or open, end of the navel cord, not through the side, so shortening the undipped navel might be a disadvantage, and 2) dipping the navel with a non-disinfectant placebo might increase the infection rate. Despite the slight difference in dipping techniques, the current study is, to the authors' knowledge, the first controlled study available to demonstrate that dipping navels shortly after birth with a commercial disinfectant, in this case NG, was effective in significantly reducing the risk for developing an umbilical infection in neonatal calves, as compared to not dipping the umbilicus. This information should encourage producers not routinely dipping navels at birth to begin using an effective navel dip, and then subsequently evaluate the umbilical stalk for the presence of omphalitis.

One of the challenges of this study was to create a case definition for umbilical infection. Palpation, rather than ultrasonography, was chosen as the diagnostic procedure for this study in an attempt to provide producers and veterinarians with an evaluation technique that is easy and economical to implement. However, in previous observational cross-sectional studies that used palpation, authors have often not provided a clear case definition or else have defined an infected umbilicus only as being "enlarged".[26] The current study tried to improve upon previous case definitions not only describing the absolute diameter of the umbilicus at three different time points, but also by considering whether the stalk was shrinking in diameter over the three-week observation period, and by considering the presence or absence of pain. It is possible that not all pain or swelling observed in the current study was the result of an infection. Bacterial culture and/or pathology confirmation would not be practical in an on-farm situation and was beyond the scope of this trial. However, there is evidence[2,11] that navel infections found by gross examination by meat inspectors are supported by bacterial culture and histopathology.

One previous study used ultrasonography to describe normal atrophy, or dissolution, of the bovine navel stalk in nine normal calves.[29] However, that study did not describe the size of the umbilical stalk over time in abnormal calves with umbilical infections. Furthermore, the ultrasonography measurements reported were taken at ages that were different (personal communication, Elizabeth Watson, 2011) than the palpation measurements reported here. Despite these differences in methodology with the current study (ultrasound vs palpation), both studies described a similar gradual decrease in the diameter of the navel stalk of normal calves over time and, in calves judged to be non-infected, the percentage size decrease from the first measurement to the last measurement was similar in both studies. Future studies should endeavor to evaluate and validate the case

definition for umbilical infection developed and utilized in this study. As part of this, future studies with much larger sample sizes may endeavor to investigate which of the individual criteria used in the current case definition (e.g. pain, diameter, failure to atrophy, increase in diameter) contribute best to creating the most accurate (sensitive and specific) case definition for diagnosing umbilical infection.

While the current study did not show significant differences in risk for umbilical infection in calves dipped with NG as compared to calves dipped with 7% tincture of iodine solution (NG = 10.9% affected, CG_{7TI} = 16.4% affected) or between calves dipped with NG as compared to calves dipped with 0.5 to 2% iodine solutions (NG = 6.0% affected, CG_{ILow} = 14.6% affected), there were numerically large reductions in risk in both comparisons for calves dipped with NG. The failure to detect statistically significant differences may be due to inadequate sample sizes for the study groups analyzed in trials 2 and 3. For trial 1, a post-hoc power analysis showed that the study had a sufficient sample size to declare, with 95% confidence and a power of 0.80, a difference between 28.3% (CG_{Nodip}) and 10.3% (NG) (1-tailed test). However, with the sample sizes available in trial 2, that study had only an estimated power value of 0.39 to detect a difference between 10.9% (NG) and 16.4% (CG_{7TI}) (1-tailed test). Similarly, with the sample sizes available in trial 3, that study had only an estimated power value of 0.40 to detect a difference between 6.0% (NG) and 14.6% (CG_{ILow}) (1-tailed test). Future studies comparing efficacy among different commercial umbilical dip products should seek to enroll larger numbers of calves. In that vein, the incidence data generated from the current study should be helpful to individuals designing future studies in estimating necessary sample sizes.

At the very least, this study demonstrates at least equal efficacy between NG and 7% tincture of iodine. Because of the aforementioned difficulties in sourcing 7% tincture of iodine, the results of this study may make NG attractive as an easily sourced and effective alternative navel dip for use on commercial dairy farms.

The authors recognize the potential limitations of doing a controlled trial on commercial dairy farms utilizing farm personnel. The issue of incomplete or missing records was already mentioned and addressed in the results section. Additionally, researchers conducting field trials should be aware of, and monitor for, the potential for bias or error to be introduced if farm staff fail to comply with enrollment or other study protocols. As an example, in the current study, herd staff could have strayed from protocol to systematically enrolled heifer or bull calves into either the NG or CG groups, respectively. However, the authors do not consider this to have happened because, in reviewing the data, roughly equal numbers of calves were assigned to both treatment groups within each of the three trials conducted; bull and heifer calves appeared to be equally assigned to NG or CG groups (gender data not reported here). Also, the number of cases where either the NG or the CG were used on two calves sequentially (not alternated) was very limited.

Opportunities abound for additional research in this area. Studies should be conducted to validate, and if needed modify, the case definition developed and used in this study for determining if a navel is infected or normal. Is there one best technique for preventing navel infections – dip, or clip and dip, or repeat dips (and if so, how many repeats and at what interval), or spray, or navel clamps or clips, or some other technique? Future studies with larger sample sizes should reexamine the relative efficacy of using NG as compared to using 7% tincture of iodine or solutions with low iodine concentrations, to prevent umbilical infections. Finally, future studies should further investigate and identify the risk factors for umbilical infections (e.g. maternity pen cleanliness, dystocia, colostrum management, time from birth to navel treatment) as well as to describe the relationship between umbilical infections and other important health events (e.g. hernia, scours, pneumonia, septicemia, death) or future performance outcomes (e.g. rate of gain, risk for culling, future milk production potential).

Conclusion

A new umbilical disinfectant, Navel Guard, was effective at reducing the incidence of umbilical infections in neonatal calves as compared to calves for which the umbilicus was not dipped shortly after birth. The risk for umbilical infection was numerically, but not statistically, reduced in calves for which the umbilicus was dipped with Navel Guard as compared to calves for which the umbilicus was dipped with 7% tincture of iodine or dipped with solutions containing low concentrations of iodine (0.5 to 2.0%).

Endnotes

[a]Navel Guard, Sirius Chemical Group, McDonough, GA
[b]Radix Laboratoires Inc, Eau Claire, WI
[c]Navel Guard information supplied by SCG Solutions LLC, McDonough, GA
[d]Ambic Non-Return Teat Dipper, Ambic Equipment Ltd, Witney, Oxfordshire, UK

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