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Randomized prospective trials to study effects of reduced antibiotic usage in abdominal surgery in cows

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ABSTRACT

Societal concerns about antibiotic resistance prompted us to evaluate the use of prophylactic and postoperative antibiotic treatments following cesarean section (CS) and exploratory laparotomy (EL) in a surgery theater within the Farm Animal Health clinic. All procedures were performed by supervised veterinary students for training purposes. Cows undergoing CS ($n = 100$) received either a prophylaxis with a single 5-g injection of ampicillin-sodium i.v. only (CSL), or in combination with postoperative i.m. injections of ampicillin-trihydrate 20% for 3 d (10 mg/kg, twice a day; CSH). Cows undergoing EL ($n = 110$) received either no antibiotic prophylaxis (ELN) or were given a single 5-g injection of ampicillin-sodium i.v. (ELL). The primary outcome measure was healthy recovery after surgery, which we assessed according to the need to treat surgery-related complications within a 10-d follow-up period based on daily clinical observations. Cows in all groups had a normal temperature and feed intake, and a satisfying clinical appearance at the end of the follow-up period. The clinical need to treat cows with antibiotics to deal with postoperative complications was higher for the CS groups than the EL groups. Within both CS and EL groups, the number of complications for each protocol was the same. However, in terms of the secondary outcomes, we observed that CSL cows required, for example, more treatments for mastitis and other diseases unrelated to the surgery than CSH cows (odds ratio 2.8; confidence interval 1.2–7.2). The percentage of infected sutures was higher for ELN cows compared with ELL cows (odds ratio 2.6; confidence interval 1.5–4.9). We estimated that 29 CSH treatments were needed to prevent 1 CS cow with serious surgery-related complications in the CSL group. Likewise, 53 ELL treatments would prevent 1 EL cow with surgery-related complications in the ELN group. We therefore concluded that it is possible to

reduce antibiotic prophylaxis in CS and EL cows. The low number cows of clinically detected complications were effectively treated with a postoperative antibiotic intervention at the moment of detection.

Key words: randomized trial, cow, surgery, antibiotics, prophylaxis

INTRODUCTION

Wound infections and sepsis are the main complications of abdominal surgeries in cows. The judicious use of antiseptic and aseptic procedures, careful tissue handling, and surgical skills to reduce the induction of hematomas and dead space are, in most cases, not sufficient to prevent a certain degree of contamination of the surgery site and probably affect the survival and performance of cows after surgery (Lyons et al., 2013). Additionally, abdominal surgery in cows is usually not performed in a dedicated operating theater; therefore, prophylactic and postoperative antibiotic treatments are frequently used in ambulatory veterinary abdominal surgeries (Chicoine et al., 2008).

The use of antibiotic prophylaxis in human surgery is based on guidelines that are commonly generated by measuring risk factors for postoperative wound infections (Bratzler et al., 2013). Among these risk factors are many aspects related to the suboptimal health of the patient, the duration of the surgery, and the classification of the wound into “clean,” “clean-contaminated,” “contaminated,” and “dirty.” In line with this classification of human wounds, exploratory laparotomies (EL) in cows should be classified as clean and cesarean sections (CS) as clean-contaminated. Again, in line with human guidelines, antibiotic prophylaxis in cows is, in general, indicated for clean-contaminated wounds and not for clean wounds. However, the number of veterinary guidelines is very limited compared with the number of human guidelines and compliance appears to be poor (Hardefeldt et al., 2017a).

As a precautionary measure, the prophylactic use of antibiotics is common following abdominal surgery in dairy cattle (Newman and Anderson, 2005; Chicoine et al., 2008). Furthermore, postoperative antibiotic

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treatments are, in our experience, standard procedure though the clinical necessity is not evidence based (Dumas et al., 2016). The growing concerns about the effect of the use of antibiotics on the selection of antibiotic resistance requires an increased focus on the prudent use of antibiotics. The objective of this study was therefore to evaluate the efficacy of 2 antibiotic protocols for EL and CS in dairy cows.

MATERIALS AND METHODS

Design and Setting

We performed a randomized parallel study with balanced randomization on cows that were used for the clinical training of veterinary students' surgical skills at Utrecht University's Farm Animal Health clinic. Students following the farm animal track were taught 2 abdominal surgical procedures: EL and CS. From December 2013 to June 2017, all cows submitted to one of these 2 surgical procedures were randomly allocated to one of the antibiotic prophylactic protocols. All procedures, including the use of different antibiotic protocols, were approved by the Ethical Committee of Utrecht University (2013.III.09.062, 2013.III.01.001). We received no external financial support for this research.

Inclusion of Cows

Some CS cows were inseminated at the clinic, whereas other pregnant cows with a known insemination date were bought for CS and arrived at the clinic throughout the year at 7 or 8 mo pregnant. All these cows underwent standard monitoring, with their blood progesterone concentrations measured 3 times a week and clinical observations by the clinic's veterinary students and staff. To ensure that all CS procedures could be taught during working hours, we frequently induced parturition using hormonal induction. This hormonal induction was based on prodromal signs and was initiated only when the calculated pregnancy had lasted for 265 d or longer. Induction consisted of a single injection of dexamethasone (0.06 mg/kg of BW) approximately 36 h before the scheduled CS. At the discretion of the clinician, this was sometimes followed by an injection of prostaglandins (25 mg) approximately 12 h before the CS. Some cows were in partu earlier than expected and were submitted to CS before the hormonal induction had been completely finished or even started. When deemed necessary, i.v. injections of clenbuterol hydrochloride (0.3 mg/cow) were applied for uterus relaxation. Although vaginal delivery of the calf was

precluded, the presence of vaginal dilatation was part of the routine clinical examination before CS and thus recorded. Cows were not included in the study if, for example, they unexpectedly and spontaneously delivered during the night. Cows from the teaching herd were eligible for EL if they were clinically healthy and had not previously undergone right flank laparotomy.

Surgical Preparations and Procedures

Per protocol, all cows were completely washed by trained technicians, preferably the evening before surgery, but at least 2 h before entering the preparation room. Students performed a pre-anesthetic clinical examination just before the cows were transferred to the preparation room. The CS and EL cows were prepared for standing flank surgery by clipping and shaving an area on their left flank for CS and on the right flank for EL with the 12th rib and the tuber coxa as horizontal limits. The spinal vertebral processes and a horizontal line at the height of the knee were used as vertical limits.

The surgical site was further prepared using antiseptic washes with 70% ethanol and chlorhexidine in ethanol 70% as disinfectants. When a CS cow was in partu, additional epidural anesthesia was given between the first and second sacral vertebrae. Proximal paravertebral anesthesia was used in EL cows and 60 to 80 mL of local infiltration anesthesia was used in CS cows. Due to changing market availabilities of registered products, different generic products of procaine 2 to 4% with and without adrenaline were used and dosed according to cascade regulations.

After preparation, the cows were moved to the operating theater. As a rule, 2 inexperienced veterinary students and 1 clinician from among the veterinary staff performed all CS and EL. Before entering the operation room, they put on a cap, surgical mask, and designated clothes and boots. They washed their hands with soap and used 70% alcohol for disinfection before putting on their surgical gloves and gowns. Cotton covers were used to cover the cows and parts of the cow crush.

In cows undergoing CS, the abdominal cavity was opened on the left flank using straightforward incisions of the skin and all muscle layers, and explored manually. Both students individually tried to externalize the gravid uterine horn, which was finally opened and the calf removed. It was generally not possible to completely prevent intra-abdominal contamination with uterine fluids. The uterine incision was sutured using the Utrecht modified Cushing method (Baird, 1989). The abdominal cavity was closed using absorbable polyglactin (Vicryl, Ethicon, Somerville, NY) for

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