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Ultrasonographic assessment of standing laparotomy wound healing in dairy cows

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ABSTRACT

The surgical wounds of 40 cows with a standing clean laparotomy were assessed 10–15 days after surgery. The abdominal wall thickness on the upper (w1), the middle (w2) and the lower (w3) third of the wound (and the contralateral flank n1, n2, and n3), the presence of edema, cavitary lesion, capsulated lesion, or visualization of shadow artifact in the wound were assessed ultrasonographically. On day 30, wound healing status (normal or surgical site infection (SSI)) was determined. Five out of 39 cows (12.8%) had SSI. A significant positive correlation was found between w3 and edema ($p < 0.01$; $r = 0.44$), w3/n3 and edema ($p < 0.05$; $r = 0.32$), w3 and pain on wound palpation ($p < 0.01$; $r = 0.41$); w3/n3 and the presence of pain ($p < 0.002$; $r = 0.49$) and w2/n2 and pain when palpating the wound ($p < 0.05$; $r = 0.33$). No association was found between the ultrasonographic evidence of edema and SSI ($p = 0.10$), cavitary lesion and SSI ($p = 0.65$), encapsulated lesion and SSI ($p = 1$), and shadow artefact and SSI ($p = 1$). The wound ultrasonography 10–15 days after surgery was not predictive of abnormal wound healing.

1. Introduction

The standing laparotomy is common surgical procedure in dairy practice (Woodie, 2004). The common complications of the celiotomy are wound haematome, seroma, phlegmon, abscesses and retroperitoneal abscessation (Robson, 1988). The data concerning surgical wound infection rate in cattle is scant in the literature. This infection rate was estimated to 2.4% in standing laparotomies (Desrochers et al., 1996), to 4.3% in standing animals with clean surgery (Bédard et al., 2001), and 22.1% in cases of contaminated surgeries like caesarean sections (Seger et al., 1994). The ventral abdominal approach was associated with 35.7% of wound infections (Desrochers et al., 1996). Those studies were all performed under hospital setting in which the environment can be considered less contaminated than in on-farm settings. A recent study indicated that the wound infection rate was 8.9% right standing omentopexies in on-farm setting (Roy et al., 2008).

The diagnosis of wound infection or delayed wound healing is classically based on the observation of wound swelling, discharge and dehiscence (Trout et al., 1994). Since wound infection problems are commonly observed in the late term of the wound healing process (Desrochers et al., 1996; Bédard et al., 2001), an earlier objective diagnosis of wound infection could be helpful in order to manage these problems more efficiently.

Ultrasonography is an easy imaging technique that can be used for the assessment of the abdominal wall in human (Mewly and Gudinchet, 2004), horses (Wilson et al., 1987), and dogs (Trout et al., 1994). Normal ultrasonographic aspect of the upper flank has previously been described in cattle (Buczinski et al., 2010).

The first objective of this study was to describe ultrasonographic aspect of the surgical wound 10–15 days after non contaminated standing laparotomy in on-farm setting and its relation to the local clinical signs. The second objective of this study was to describe the ultrasonographic findings of cattle following surgical site infection (SSI) cases compared with non SSI cases.

2. Material and methods

The study protocol was approved by the ethical comitty (Comité d'Éthique et d'Utilisation des Animaux) of the Faculté de Médecine Vétérinaire (FMV), Université de Montréal. The animals that were used in this study were Holstein dairy cows from clients of the bovine ambulatory clinic of the FMV that underwent a standing laparotomy for clean surgeries (omentopexy, pyloropexy or explorative laparotomy with no peritonitis). Briefly, the flank was shaved with a 40 surgical blade, washed and prepared aseptically. A 15–20 cm incision was performed and routinely closed with absorbable multifilament suture material (Vicryl USP 2, Ethicon, Sommerville, NJ, USA or Catgut Chromic USP 3, Serag Wiessner, Naila, Germany) with a simple continuous pattern for the muscles (1 plan including the peritoneum and the transverse muscle and 1 plan including both oblique muscles). The skin was finally closed with a Ford interlocking suture pattern (Supramid USP 3 + 4, Serag Wiessner, Naila, Germany). The mean duration of the surgical intervention was 49 min (med: 49.5 min; range 25–80 min). An antibiotic treatment

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Table 1
Physical examination of the surgical wound (10–15 days after the surgical procedure) in 35 cows with normal healing and 5 cows with surgical site infection 30 days after the surgery.

Parameter	Score*	Normal healing at day 30 (n = 35)	Surgical site infection at day 30 (n = 5)
Discharge[a]	0	27	4
	1	6	1
	2	1	0
	3	1	0
Edema[b]	0	20	0
	1	7	3
	2	6	2
	3	1	0
Seroma[c]	0	33	5
	1	2	0
	2	0	0
	3	0	0
Emphysema[d]	0	32	4
	1	2	0
	2	1	1
	3	0	0
Pain[e]	0	25	4
	1	8	1
	2	1	0
	3	1	0

* The score for each parameter was based on a 4 units-scale from 0 (normal) 3 (severely abnormal).
[a] 0: Absence of discharge; 1: small quantity of dry secretions; 2: small quantity of wet secretions; 3: large quantity of secretions.
[b] 0: Absence of edema; 1: edema difficult to observe; 2: edema easy to note; 3: severe edema.
[c] 0: Absence of seroma; 1: observation of a seroma less than 5 cm of diameter; 2: observation of a seroma between 5 and 10 cm of diameter; 3: seroma of more than 10 cm of diameter.
[d] 0: Absence of emphysema; 1: small quantity of crepitus when palpating the wound; 2: the skin is elevated near the wound by emphysema; 3: there is a diffuse crepiting area.
[e] 0: Absence of pain when palpating the wound; 1: the cow manifests some discomfort when palpating the wound; 2: the cow always manifests discomfort when palpating the wound; the cow tries to kick when palpating the wound.

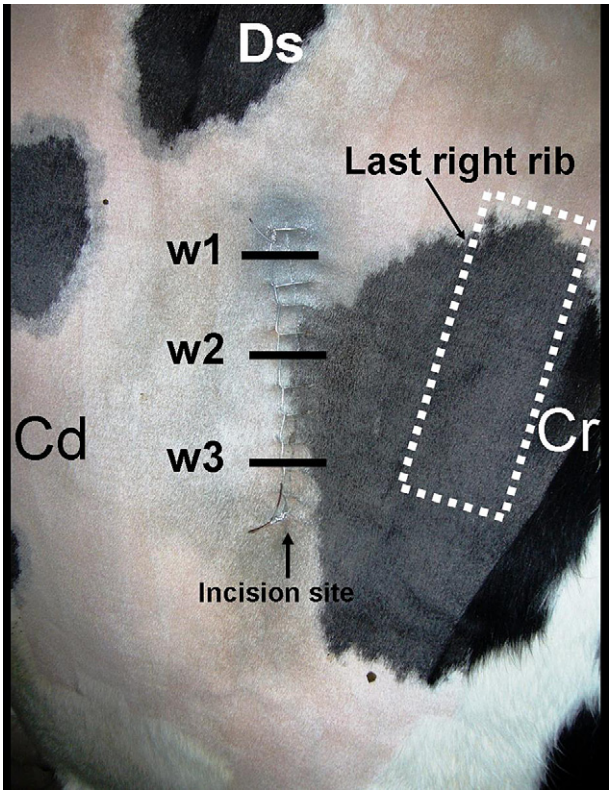

Fig. 1. Anatomical landmark used for the ultrasonographic assessment of surgical wound healing in dairy cows 10–15 days after the surgery The surgical wound was located 10 cm caudally to the last rib and 10 cm ventrally to the transverse processes of the lumbar vertebra and extending on 20 cm. w1: site where the first ultrasonographic measurement of the flank thickness was measured on the upper third of the wound; w2: site where the second ultrasonographic measurement of the flank thickness was measured on the middle third of the wound; w3: site where the third ultrasonographic measurement of the flank thickness was measured on the lower third of the wound; Cd: caudal; Cr: cranial; Vt: ventral; Ds: dorsal.

was started with procain penicillin (22,000 IU/kg, BID, 3d) when the standard paravertebral anesthesia as described by Roy et al. (2008) was performed. The body condition score of the cow was also noted on the day of the intervention. This score was assessed on a 5-point scale (1 = thin to 5 = fat) at 0.25-unit increment (Edmonson et al., 1989).

Ten to fifteen days following the surgical intervention a second visit was made on the farm. The surgical wound was assessed by visual and manual inspection. The physical parameters that were assessed by the same operator (CB and SB) were the presence of a wound discharge, the presence of swelling due to pitting edema or fluid-filled cavity qualified as a seroma, emphysema, and pain elicited by wound palpation. Each parameter was attributed a score depending of the severity of the finding (Table 1). Ultrasonographic examination of the flank with the cow standing was then performed as previously described (Buczinski et al., 2010). Briefly, the abdomen was rinsed with warm water and contact gel was applied on the wound to improve the quality of the ultrasonographic images. Ultrasonography was performed using a portable ultrasound unit (LogiqBook, GE, Wawatosa, USA) and a 8 MHz linear transducer. A high frequency probe was chosen to have a good resolution of superficial structures. A sectorial transducer was not used to avoid limited near field of view with these scanners (Blond and Buczinski, 2009). The body thickness was recorded on the upper (w1), the middle (w2) and the lower (w3) third of the wound. The transducer was applied perpendicularly to the wound and the measurements were performed just cranially to the incision line (Fig. 1). Then the same area of the contralateral flank was also scanned in those cows. Only cows without previous surgical wound on the contralateral flank were included in the study. The body wall thickness on the upper third of (n1), on the middle third (n2) and the lower third (n3) of the typical laparotomy site were then determined as previously described (Buczinski et al., 2010) in order to obtain the wound/normal flank ratios (w1/n1; w2/n2; w3/n3). The characterizations of the ultrasonographic characteristics of the wound were also recorded. The hypoechogenic foci of the wound interpreted as wound edema (Weber, 2009) were noted if observed (Fig. 2). The presence of a cavitary lesion, encapsulated lesion, the presence or absence of shadow artifact in the abdominal wall were systematically assessed as possible indicators of abnormal wound healing or infection (Hashefi, 2009). No local wound therapy or puncture was attempted in any case during the study. The stitches were removed 13–15 days after the surgery.

Thirty days after the surgical procedure the wound infection rate was determined by the same operator (CB) via phone conversation to the owner (Desrochers et al., 1996; Bédard et al., 2001). The owner was asked for standardized questions as previous studies in cattle (Desrochers et al., 1996; Bédard et al., 2001). Emphasis was based on the extent of purulent discharge since focal purulent discharge at the stitches level is not considered as a surgical site infection (SSI) (Mangram et al., 1999). The SSI was therefore defined as the observation of purulent discharge that was observed from the incision site. The owner was also asked for the presence of wound area swelling since it may be a clinical sign of deep incisional SSI, which does not systematically lead to spontaneous wound discharge (Mangram et al., 1999).