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Transrectal guidance of the ovaries reduces operative time during bovine laparoscopic ovariectomy

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ABSTRACT

The main objective of this study was to evaluate the effects of transrectal guidance of the ovaries by an assistant on operative time during bovine laparoscopic ovariectomy. Twenty four clinically healthy Holstein dairy cows were divided randomly into two groups. In the transrectal guidance group, an assistant grasped the ovaries via the transrectal route and pulled them to a position where they could be visualized with a camera. On the other hand, the control group was operated without guidance. The time required to remove both ovaries in the guidance group was shorter than that in the control group ($P < 0.01$). We concluded that laparoscopic ovariectomy with transrectal guidance of the ovaries can substantially shorten operative time, thereby greatly contributing to animal welfare and to reducing the burden on the operator.

KEY WORD: cow, laparoscopy, ovariectomy, transrectal

Bovine ovariectomy is considered a necessary farm animal management technique, not only for research on reproductive endocrinology [10, 13], but also for improving feeding efficiency in feeder cattle [15] and for treating ovarian diseases, such as ovarian tumors and granulosa cell tumors [3, 7, 15]. Ovariectomy used to be performed by colpotomy or laparotomy [2, 5, 12]. In these methods, the operator pulls the ovary into the vagina, where it is ligated and ablated under direct vision or with the aid of a Willis spay instrument or Kimberling-Rupp (K-R) spay instrument. During ovariectomy by colpotomy, postoperative bleeding can easily go unnoticed and can thus be fatal. Ovariectomy by laparotomy is performed under direct vision, making it possible to reduce the risk of complications; however, the size of the cow or a small uterus (such as during non-pregnant stages) may make it difficult to confirm the ovary position under direct vision, sometimes making it impossible to complete the desired treatment. Furthermore, ovariectomy by colpotomy or laparotomy increases the risk of adhesions or bleeding from the ovarian pedicle; in colpotomy, peritonitis may result in life-threatening complications [5, 12].

In contrast, laparoscopic ovariectomy offers various advantages, which are being increasingly recognized. Minimal invasion of the abdominal cavity is not only esthetically advantageous, but also therapeutically beneficial. Because this method causes little invasiveness and pain, patients are admitted to a hospital for shorter periods and return to normal production levels quicker [8, 9, 11]. In addition, the use of a laparoscopic camera and specialized forceps makes it possible to perform ovariectomy in a reliable manner.

However, in laparoscopic ovariectomy, the uterus and ovaries are difficult to visualize when over fattening results in pronounced fat deposits in organs or when insufficient withholding of food makes it impossible to secure sufficient intra-abdominal space; as a result, the surgery is prolonged, thereby placing significant burden on the cow.

Rectal palpation is a physical examination commonly used for the diagnosis of reproductive

disturbance and pregnancy [6]. Using this technique, the ovary or uterus can be palpated within a few sec. Thus, we investigated the effect of transrectal guidance of the ovaries by an assistant on operative time during laparoscopic ovariectomy.

All animal experiments were performed in compliance with the Guide for the Animal Care and Use Committee at Azabu University, School of Veterinary Medicine (No. 160829-3). In total, 24 Holstein dairy cows (28.2–98.9 months, 1-5 parities, weight 406–698 kg, BCS 2.75–4.00) from a commercial dairy farm were included in the present study (Table 1). These cows were randomly divided into two groups: with (guidance group) and without (control group) transrectal guidance of the ovaries by an assistant (12 cows each). All cows were submitted to general status examinations and blood tests prior to surgery and on days 1 and day 14 after surgery. All surgeries were performed by a veterinary surgeon who performs laparoscopic examinations and surgeries on a daily basis, a camera assistant, and a surgical technician. Transrectal manipulation of the ovaries in the guidance group were also performed by a veterinary technician who performs transrectal examinations on a daily basis.

The cows were allowed free access to water at all times but were prevented from feeding for 24 hr prior to surgery. Although one study reported that a sufficient visual field could not be obtained if food was withheld in the rumen for less than 36 hr [1], we were able to procure sufficient intra-abdominal space by withholding food for only 24 hr prior to surgery. First, 5,000 IU/kg procaine penicillin G (Kyoritsu Seiyaku Inc., Tokyo, Japan) was injected into the muscles 1 hr before surgery and for 3 days after surgery. The cows were restrained in a standing position. Local anesthesia consisted of a lumbar epidural injection of 2% lidocaine hydrochloride (Pfizer Japan Inc., Tokyo, Japan) 0.2 mg/kg and 2% Xylazine hydrochloride (Selactar 0.2%; Bayer, Ltd., Tokyo, Japam) 0.05 mg/kg were administrated between the first and second lumber vertebrae using the epidural needle (16G, 12 cm in length; Hakko syoji., Tokyo, Japan).

With a left abdominal incision, the risk of tissue damage is lower than if a right abdominal incision was utilized, and the ovaries and uterus can be viewed more easily [14]. An approach from the right abdominal wall is obstructed by the omentum majus; however, an approach from the left flank enabled sufficient visualization of the uterus and ovaries. We clipped the hair, cleaned and disinfected the region extending from the lumbar spine in the left abdomen to the lower abdomen across a width of 25 cm, from the last rib to the tuber coxae; at the site of the ports, an infiltration anesthesia with lidocaine 2% was performed. The laparoscopic camera port (port 1) site was approximately 15 cm rostral from the left tuber coxae and approximately 10 cm towards the lower abdomen from the transverse processes of the lumbar vertebrae. After inserting the trocar (11 mm in diameter, 20 cm in length; KARL STORZ GmbH & Co. KG, Tuttligen, Germany), CO_2 gas was injected into the abdominal cavity with a pressure of 10 mmHg. There were two surgical access ports: one (port 2) situated 10–15 cm towards the lower abdomen from port 1 and the other (port 3) situated approximately 10 cm towards the lower abdomen from port 2 and approximately 5 cm cranial to the vertical line from the tuber coxae (Figures 1A and 1B).

First, a 30° laparoscope (10 mm in diameter, 57 cm in length; KARL STORZ GmbH & Co. KG, Tuttligen, Germany) was inserted through port 1. In the control group, two pairs of grasping forceps (HOPKINS Forceps, 43 cm in length; KARL STORZ GmbH & Co. KG, Tuttligen, Germany) were introduced through ports 2 and 3 to identify the uterus, which was then grasped with forceps; we then followed along the right and left uterus horn until we confirmed the ovaries. In the guidance group, the designated assistant grasped the ovaries via a transrectal approach and pulled them to a position where they could be visualized with the laparoscopic camera. In both groups, once the ovaries were identified with the laparoscopic camera, the left ovarian parenchyma was grasped with the grasping forceps inserted through port 2; an injection

cannula (43 cm in length; KARL STORZ GmbH & Co. KG, Tuttligen, Germany) was then inserted through port 3, and 10 ml of lidocaine was injected into the mesosalpinx and the mesovarium. The ovary was pulled with the grasping forceps, and the extended mesovarium was cauterized close to the ovary with a vessel-sealing device (Ligasure Maryland 44; Medtronic plc, Dublin, Ireland) inserted through port 3. In the present study, we used a vessel-sealing device that can seal blood vessels of up to 7 mm in diameter. The ovarian artery is expected to have a diameter of 2.5 mm [4]. Once the cauterization site turned white, the mesovarium was ablated with an organ cutter (Figure 1C); while confirming that there was no bleeding from the ablation surface, this process was repeated until the ovary was completely detached. While continuing to grasp the detached ovary with the forceps, the ovary was removed from the abdominal cavity through port 2. The right ovary was also resected with the same procedure.

In the control group, if more than 90 min passed after the skin incision, the designated assistant performed transrectal guidance of the ovaries. Following surgery, the abdominal cavity was deflated through port 1, and the skin incision sites were closed with a stapler (WiSM Skin Stapler; Keisei Ika KK, Tokyo, Japan). For cows with large ovaries which therefore required a longer incision in the muscle in access port 3 for removal from the abdominal cavity, the muscle layer was continuously sutured with synthetic absorbable suture material (USP 4) before stapling the skin incision.

Blood samples were obtained from the jugular vein prior to surgery and 1 day and 14 days after surgery. Collecting samples were used for counting of red blood cells (RBC) and white blood cells (WBC), Platlet (PLT) and hematocrit (Ht) analysis by automated cell counter (PCE–170, ERMA Inc, Tokyo, Japan) within 30 min after collection.

All statistical analyses were performed using the statistical software (Statcel, 4th edition,

OMS Publishing, Saitama, Japan). Data were tested normality distribution and as this was confirmed, Student's *t*-test was used to compare the mean values resulting from both treatments groups (control and guidance groups). Data in the present study were expressed as mean ± standard deviation of the mean. Statistical significance was defined as $P<0.05$.

The time required from skin incision to the completion of bilateral ovariectomy in the control group (63 ± 25.2 min) was significantly longer than that in the guidance group (24 ± 6.6 min) ($P < 0.01$;Figure 2). In a previous study, the duration of ovariectomy in cows was reported to be 120–150 min [1]. In the present study, however, transrectal examination enabled us to complete ovariectomy in a much shorter period of time.

None of the 24 cows demonstrated any abnormalities at general status examinations or blood tests prior to surgery or at day 1 or day 14 after surgery; furthermore, no differences were observed in blood tests between the groups (Table 2).

In general, it was necessary to use large traumatic forceps with relatively large teeth to avoid losing hold of the uterine horn; this procedure can cause bleeding and lacerations in the uterine serosa [1]. However, in the present study, an assistant grasped the ovaries via a transrectal approach, which enabled us to avoid injuring the uterine serosa. We can therefore confirm that the transrectal assistance for ovariectomy by laparoscopy in cows helps to protect the cow from physical damage.

The local anesthesia is necessary when the ovariectomy is done even the method excluding the laparoscopy. The ovariectomy by colpotomy or laparotomy increases the risk of adhesions or bleeding from the ovarian pedicle [5, 12]. Even if the laparoscopic ovariectomy need special instruments, it is reduce the risk of complications because performed under direct vision. Additionally the small incisions and little pain are return to normal activity level quickly [8, 9, 11].

In conclusion, our results indicate that the combined technique of using laparoscopy and a

transrescal assistant is effective for ovariectomy in cows because it reduces operative time, physical damage, and the burden on the operator.

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FIGURE LEGENDS

Fig. 1 Images showing portals for laparoscopic ovariectomy via the left flank.

Image (A) and illustration (B) showing the surgical site after insertion of the laparoscope and forceps. The laparoscope (①) and two forceps portals (②, ③) were established. The port (①) was approximately 15 cm rostral from the left tuber coxae (a) and approximately 10 cm towards the lower abdomen from the transverse processes of the lumbar vertebrae (b). The port (②) situated 10–15 cm towards the lower abdomen from port 1 (c) and the port (③) situated approximately 10 cm towards the lower abdomen from port 2 (d) and approximately 5 cm cranial to the vertical line from the tuber coxae (e). The ovary was grasped with forceps and cauterized by a vessel-sealing device (C). Cran = cranial, Caud = caudal, LUH = left uterus horn, RUH = right uterus horn, OP = ovarian pedicle, OV = ovary, TC = tuber coxae.

Fig. 2 Bar graph (mean + SD) showing the surgery time of laparoscopic ovariectomy (control vs guidance group). Statistically significant differnces ($P < 0.01$), as determined by Student ‘s *t*-test.

Table 1. Description of the experimental cows (n=24; 12 control cows and 12 guidance cows) used for laparoscopic ovariectomy.

No.	Group	Breed	Age (Months)	Parity	Body weight (kg)	BCS*
1	control	Holstein	40.0	2	406.0	2.75
2		Holstein	28.2	1	454.0	2.75
3		Holstein	33.8	2	478.0	3.00
4		Holstein	36.1	1	488.0	2.75
5		Holstein	29.6	1	555.0	3.50
6		Holstein	57.8	2	559.0	3.00
7		Holstein	37.6	1	582.0	3.50
8		Holstein	52.0	3	587.0	3.25
9		Holstein	38.2	1	593.5	3.50
10		Holstein	92.9	3	600.0	3.75
11		Holstein	78.4	4	643.0	3.75
12		Holstein	40.8	1	698.0	4.00
		mean±SD	47.1±20.1	1.8±1.0	553.6±83.3	3.29±0.4
13	guidance	Holstein	29.3	1	462.0	2.75
14		Holstein	36.6	2	413.0	2.75
15		Holstein	39.7	1	456.0	2.75
16		Holstein	31.3	1	481.0	2.75
17		Holstein	58.6	2	527.0	3.00
18		Holstein	55.2	2	530.0	2.75
19		Holstein	66.1	3	545.0	3.50
20		Holstein	45.1	1	560.0	3.50
21		Holstein	71.5	3	575.0	3.50
22		Holstein	98.9	5	595.5	3.75
23		Holstein	46.8	1	617.0	4.00
24		Holstein	66.8	3	645.0	3.75
		mean±SD	53.8±20.0	2.1±1.2	533.9±70.2	3.23±0.5

*Body condition Score

Table 2. Profile of blood examinations prior to surgery and on day 1 and day 14 after surgery.

		pre		1d		14d	
		control (n=12)	guidacne (n=12)	control (n=12)	guidance (n=12)	control (n=12)	guidance (n=12)
RBC	$\times 10^4/\mu L$	697±115	609±246	679±141	726±122	653±93	631±109
WBC	/μL	8,308±2,627	8,392±6,829	9,042±3,909	8,325±4,336	8,517±3,852	8,217±2,730
PLT	$\times 10^4/\mu L$	49±13	43±38	59±27	40±22	30±20	42±22
Ht	%	35±9	33±10	31±6	34±5	33±4	33±4
Fibrinogen	mg/dL	500±148	500±341	583±199	492±198	267±98	327±237

RBC = red blood cell, WBC = white blood cell, PLT = platlet, Ht = hematocrit

Fig. 1

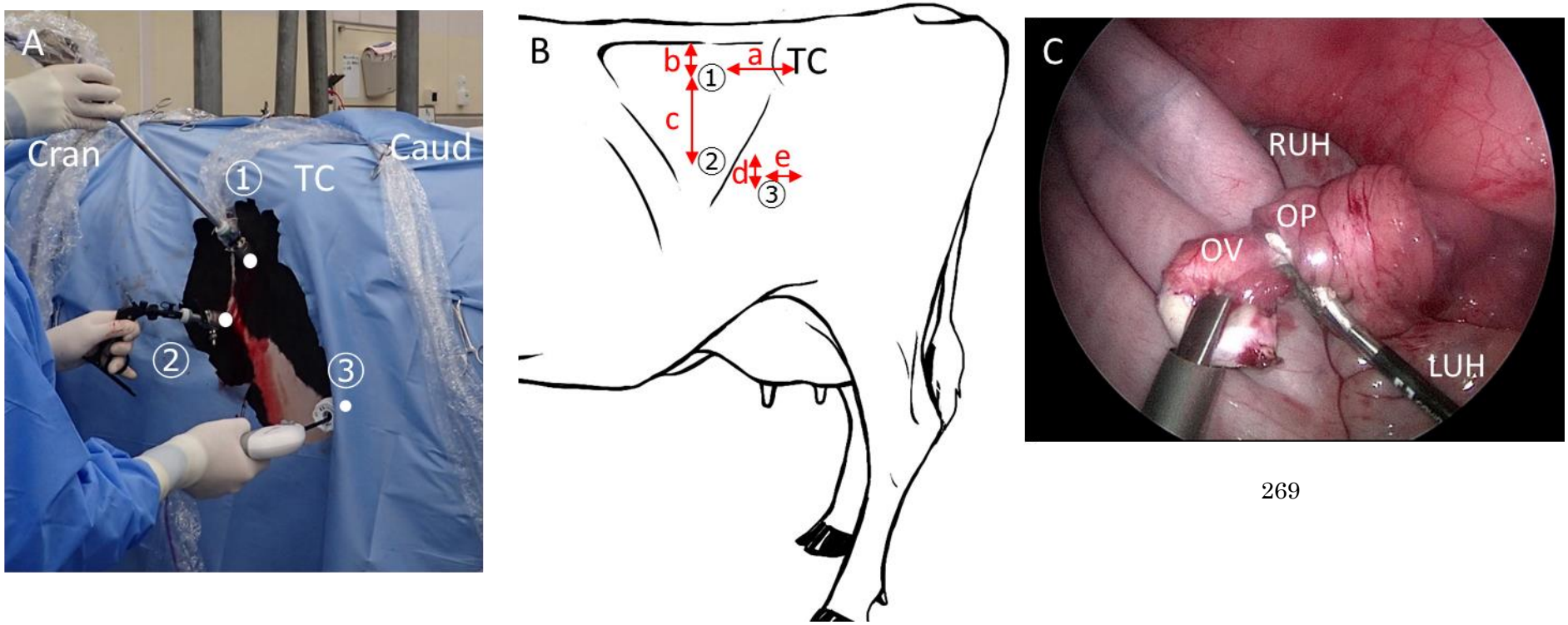
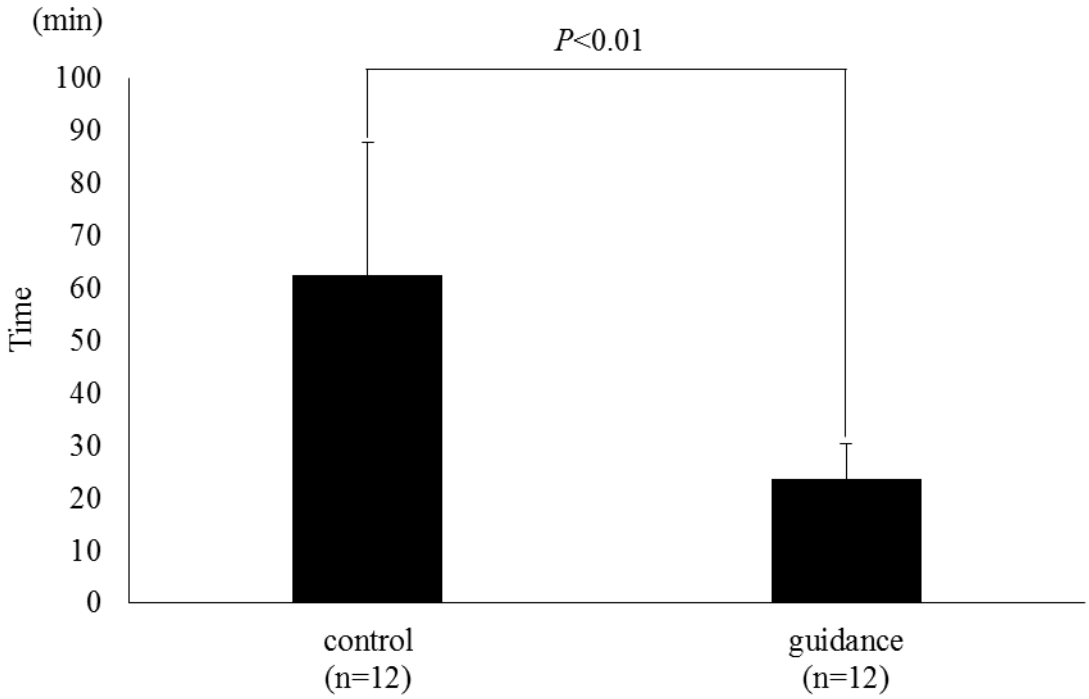


Fig. 2


(min)
P<0.01
100
90
80
70
60
50
40
30
20
10
0
Time
control
(n=12)
guidance
(n=12)