

EVALUATION OF VAGINAL IMPLANT TRANSMITTERS IN ELK (*CERVUS ELAPHUS NELSONI*)

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Abstract: The effects of vaginal implant transmitters for tissue damage after 11 wk in 13 captive adult elk (*Cervus elaphus nelsoni*) and subsequent reproductive performance in 38 free-ranging elk were evaluated. Vaginal implant transmitters are designed to be shed at parturition and are used to locate birth sites of wild ungulates; however, potential adverse effects of these transmitters on tissues associated with the vaginal walls or subsequent reproductive performance have not been assessed. Vaginal implant transmitters consist of a transmitter encased in inert acrylic with an antenna trailing out the distal end and wings at the proximal end to hold the transmitter in place. Using a laparoscope on sedated captive elk, necrosis or measurable differences in tissue trauma between designs with wing spans of 80 versus 150 mm over an 11-wk trial were not observed. After the captive elk trial, vaginal implant transmitters with 80-mm wings were placed into 38 pregnant wild elk, and 31 live births were documented. Fates of seven calves were not determined, because their transmitters were not shed at the birth site. We recaptured 36 of these cow elk again in fall 2003 or spring 2004, and 32 were pregnant. This study was unable to document any short- or long-term effects of vaginal implant transmitters on reproductive performance of cow elk in captive and free-range environments.

Key words: *Cervus elaphus nelsoni*, elk, laparoscope, vaginal implant transmitter.

INTRODUCTION

Quantifying survival and causes of mortalities during the first few months of life of ungulates is difficult because of the many challenges of documenting the survival of neonates immediately after parturition. Various techniques have been used to capture neonates, including helicopter captures, monitoring activity via radiotelemetry to locate sedentary females, direct observations of parturient females, and random searching, but all have proven ineffective in documenting mortalities that may occur at birth.^{2,6,8,10} Only recently have biologists used vaginal implant transmitters (VIT) to capture neonates at their birth sites. An early design was unacceptable because of tissue damage associated with the sutures used to hold the labia closed until parturition in mule deer (*Odocoileus hemionus*).³ More recently, a VIT was constructed with flexible plastic wings made from progesterone-free, controlled implant drug release (CIDR) devices that hold the transmitter in place when it is inserted into the vagina.¹ CIDRs that contain progesterone are used to synchronize estrous in domestic ungulates

and are left in place for 2 wk and then removed before artificial insemination. Wings of CIDR-s, sized for domestic sheep, span 58 mm, whereas wings of CIDR-b, for domestic cattle, span 150 mm. The wing width for both sizes of CIDRs is 16 mm.

CIDR-s have been attached to radio transmitters to aid in capture of neonates at birth sites of white-tailed deer (*Odocoileus virginianus*), black-tailed deer, and elk (*Cervus elaphus nelsoni*).^{1,2,4,10} These studies demonstrated that VITs with wings from CIDRs made it possible to efficiently locate birth sites and aided in the capture of newborn calves; however, none of the studies described any short- or long-term effects on reproductive performance of the female when the VIT was left in place for several months. In this study, we documented that wings that span 58 mm often shed prematurely from elk, because 35 of 38 VITs were shed prematurely in spring 2002. The goals of this study were to 1) evaluate whether VITs caused tissue damage while in place for 11 wk (the typical length of time between placement of a VIT and parturition in many wild ungulate studies) and 2) detect whether any carryover effects occurred on reproductive performance during the following reproductive cycle in free-ranging wild elk.

MATERIALS AND METHODS

Captive elk trial: Two sizes of wings for VITs (Advanced Telemetry Systems Inc., Isanti, Minnesota 55040, USA) were tested; otherwise, the transmitters were identical in shape. Transmitters were

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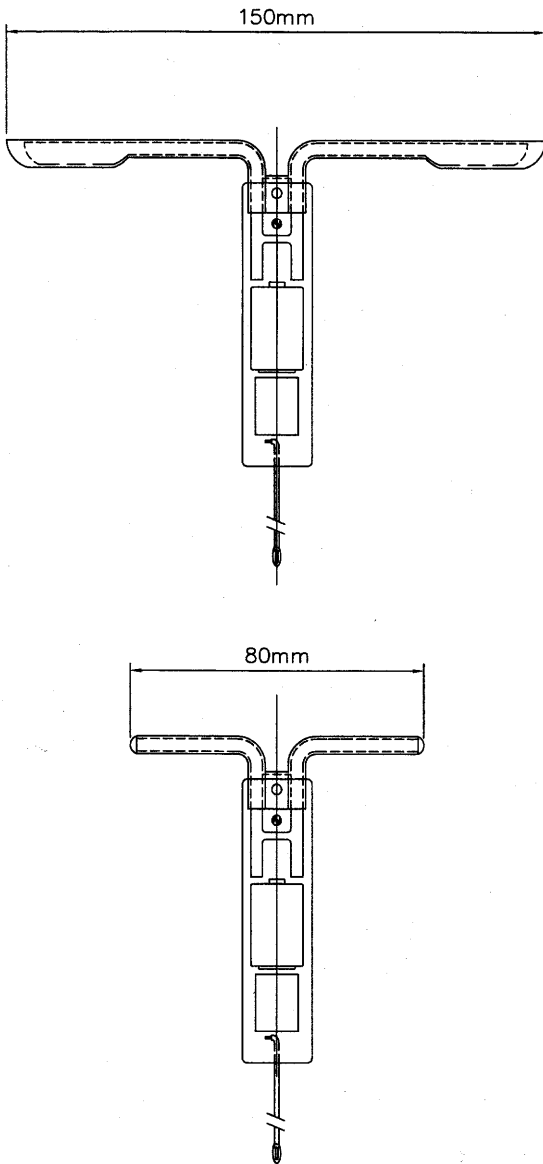


Figure 1. Schematic diagram of VITs with 80- and 150-mm wings. Antenna length was 160 mm in each design.

encased in acrylic plastic molded into a cylinder 78 mm in length and 19 mm in diameter. A braided-wire antenna extended 160 mm from the distal end of the transmitter body. Progesterone-free CIDR-b (150-mm span) as one design was used, and in a second design, the CIDR-b was trimmed to an 80-mm span, and the tips were covered with a biologically inert silicone sealer. In both designs, the CIDR extended proximally 10 mm beyond the body of the transmitter (Fig. 1).

VITs were placed in 13 bottle-raised elk (4–11

yr of age) maintained at captive holding facilities at the Starkey Experimental Forest and Range.⁵ On 13 November 2002, each elk was hand-injected with 1.5 ml of xylazine hydrochloride (TranquiVed, VEDCO, Inc., St. Joseph, Missouri 64507, USA; 100 mg/ml i.m.) while the animals were restrained in a 0.75- by 2-m holding chute. While the elk were in the chute, gross external examinations were performed to detect any lesions or injuries. After injection, animals were released into a 15- by 15-m pen until they were immobilized. The animals were placed in lateral recumbency, and the VITs were inserted so that the base of the wings was near the cervix.¹ VITs were individually bagged and soaked in a 3% sterile solution of chlorhexidine (Novasan, Wyeth Division, Ft. Dodge Animal Health, Overland Park, Kansas 66225, USA) for >24 hr before insertion. A modified speculum made from a 28-mm (outside diameter) 42-cm-long polyvinyl chloride (PVC) pipe was used. To make an insertion over the pubic bone easier, the end of the speculum was cut at a 45° angle, and the edges were rounded with sandpaper. The speculum was marked at 18 and 26 cm to mark the depth of insertion. A 16-mm (outside diameter) PVC pipe was used as a plunger to force the VIT out of the speculum. The first 15 cm of the speculum was covered with a sterile surgical lubricant (Surgilube, E. Fougera, & Co. Melville, New York 11747, USA) before insertion, and the speculum and plunger were inserted into the vagina until the cervix was palpable. The speculum and plunger were withdrawn 1 to 2 cm. The plunger was held steady, and the speculum was withdrawn, leaving the wings of the VIT near the cervix. The plunger and speculum were transported between animals in a 10.3-cm (outside diameter) by 60-cm-long container containing a 3% chlorhexidine solution. After insertion, the distal tip of the antenna usually protruded outside the labia 1 to 3 cm, depending on the body position of the elk. None of these elk were pregnant, but 11 had born calves previously. Seven elk were fitted with VITs with 150-mm wings, and six elk received VITs with 80-mm wings. After insertion of VITs, the xylazine hydrochloride was antagonized with 8 ml tolazoline hydrochloride (8 ml, 100 mg/ml i.v., Akorn, Inc., Decatur, Illinois 62522, USA). All elk recovered uneventfully and were released into a 125-ha pasture, where they remained for the next 11 wk with 43 other bottle-reared adult cow elk.

On 29 January 2003, all 56 elk were corralled and sorted, and the cows with the VITs were moved through the handling chute where each animal was inspected for injuries, and the labia were examined for any lesions that may have been caused by the

antenna. Subsequently, each elk was hand-injected with 1.5 ml of xylazine hydrochloride (100 mg/ml i.m.). When immobilized, the labia were again examined for lesions, and the antenna was grasped and the VIT pulled out. The vaginal walls were dilated with an aluminum tube approximately 3 cm in diameter, and a laparoscope was used to examine the vestibule, vagina, and cervix for tissue damage. The following scores and criteria to assess effects of VITs on the vaginal walls and vestibule were developed: 1, clean with no or only minor irritation or redness; no striations; 2, irritation present as defined by red tissue with some erosion of tissue; mucous discharge light in amount and color with no odor; 3, deep erosion present with or without strong odor, with heavy mucous discharge; white to yellow drainage; and 4, perforation of vaginal wall with or without strong odor with heavy mucous discharge.

Wild elk trial: During 24–26 March 2003, 38 pregnant elk were captured from the Wenaha and Sled Springs management units (median age 7 yr, range 2–17) in northeastern Oregon, USA, with the use of a helicopter and remote injection via dart gun of carfentanil citrate (1.2 ml, 3 mg/ml i.m., Wildlife Pharmaceuticals, Fort Collins, Colorado 80524, USA) and xylazine hydrochloride (1 ml, 100 mg/ml i.m.). Each elk was radiocollared, and pregnancy was determined using ultrasonography via a rectal exam.⁹ A VIT with a wing span of 80 mm was inserted into each pregnant elk. Penicillin G (10 ml, 300,000 units penicillin/ml i.m., G. C. Hanford Mfg. Co., Syracuse, New York 13201, USA), vitamin B₁₂ (10 ml, 1000 mcg/ml i.m., VEDCO, Inc.), selenium (10 ml, 1mg/ml i.m., BO-SE, Schering-Plough Animal Health, Union, New Jersey 07083, USA), and Clostridium 8-way vaccine (2 ml s.c., INTERVET, Inc., Millsboro, Delaware 19966, USA) also were administered. The carfentanil was antagonized with naltrexone hydrochloride (7 ml, 50 mg/ml, 50% i.v., 50% i.m., Wildlife Pharmaceuticals), and xylazine hydrochloride was antagonized with tolazoline hydrochloride (10 ml, 100 mg/ml i.v.). All animals recovered without incident. Aerial flights approximately three times per week were then conducted until 16 May and then daily from 19 May to 30 June, weather permitting, to determine the date and general location where the VITs were expelled. Ground telemetry was then used to locate the VIT and subsequently search for the newborn calf in the vicinity of the VIT and radiocollared cow elk. Visual inspection was used to determine whether the VIT was shed at the birth site. Criteria to determine a birth site included the presence of the calf or a disturbed area that may

have been devoid of vegetation. Placental material or moist ground that attracted flies was also common at birth sites. Searches were conducted by one to three people. Physical condition of newborns was assessed, and each calf was radiocollared to monitor its survival. On 29 November–2 December 2003 and 15–17 March 2004, radiocollared cows were recaptured using the same protocols as described above, and pregnancy and lactation status of each animal were determined.

RESULTS AND DISCUSSION

Captive elk trial: All animals scored 1 or 2 (Table 1), with no evidence of trauma. VITs with 150-mm wings were more easily removed compared with the 80-mm wings. We suspected that the 150-mm wings may not have achieved a perpendicular alignment to the antenna body; thus, they were easier to remove. One transmitter with 150-mm wings was shed prematurely during the 11-wk period. After each animal was examined, the xylazine was antagonized with tolazoline hydrochloride (8 ml, 100 mg/ml i.v.).

We concluded that there was no discernible difference in tissue damage between the two wing spans, tissue damage was minimal for both designs, and that the 150-mm design was easier to remove. Because one of the 150-mm VITs shed prematurely and as a group these VITs were easier to remove, the use of the 80-mm design in wild elk was preferred.

Wild elk trial: We ascertained that at least 31 cows had viable calves in three ways. Eighteen calves and 10 additional birth sites, where a calf was not captured and it was assumed that the cow moved the calf before we could find it, were identified. In November 2003, seven of these 10 cows were recaptured, and three were still lactating. For the eight cows that shed their VIT away from the birth site, we recaptured all eight cows in either November 2003 ($n = 4$) or March 2004 ($n = 8$) and expressed milk from three cows for a minimum of 31 viable calves. There was no conclusive evidence that could determine the fates of the other seven calves at birth, because the VITs were not at the birth sites. Signs of birth complications (e.g., stillbirth or cow mortality) were not observed. Between the November 2003 and March 2004 capture work, 36 of the original 38 cows that had VITs were recaptured, and 32 (89%) were pregnant, including all seven elk with calves of unknown fates. This pregnancy rate equals that observed from 1983–1999 in these game management units ($\bar{x} = 0.89$, $n = 23$ yr, range = 0.76–1.0).⁷

Table 1. Summary of the physical effects of 2 sizes of vaginal-implant transmitters placed in cow elk at Starkey Experimental Forest and Range from 13 November 2002 to 29 January 2003, northeast Oregon, USA.

Wing span	Animal	Score	Comments
150	87	1	Pulled out easily; No mucus on VIT; no irritation; vaginal wall looked clean
150	81	2	Pulled out easily; no external discharge of mucus when VIT removed; mucus on tips of wings; ulceration on right side near fornix; white intravaginal discharge
150	84	1	Pulled out easily; no mucus on VIT, small amount of mucus drained out of vagina; slight irritation on vestibule; no problem with cervix area
150	72	Na ^a	VIT shed prematurely
150	65	2	Pulled out easily; mucus on VIT and approximately 30 ml mucous liquid came out with VIT; erosion at cervix; vaginal lining disturbed and red; vestibule red with some erosion in vestibule; no smell associated with exudates
150	36Y	2	Pulled easily out; no mucus on VIT; 2 ml of mucous liquid came out with VIT; ulceration on vestibule
150	86	1	Pulled out easily; no mucus on VIT; 2 ml of clear fluid drained out when VIT removed; inadvertently missed animal on 29 January 2003—no internal examination, VIT removed 31 January 2003
80	493	2	More difficult to remove than the 150s; slight irritation near cervix
80	26	1	Very slight irritation on vestibule wall; no ulceration; slight mucus discharge
80	36G	1+	Pulled out easily; 10 ml of mucous liquid came out with VIT; slight irritation and redness on vestibule where body of transmitter rested; no ulceration
80	100	1	Pulled out moderately easily; very clean; little irritation, striation of redness where body of transmitter rested, but not where the wings pressed against vaginal wall
80	18	2	Pulled out easily; 10 ml of clear fluid drained out when VIT was removed; slight ulceration on vestibule but not at cervix
80	16	2	Pulled out with difficulty; VIT in place securely; <2 ml of fluid discharged when VIT removed; tissue appeared normal with small amount of irritation at vestibule; no lesions or signs of irritation near cervix

^a Na, not applicable.

CONCLUSION

Based on results of both our captive and free-ranging studies on elk, there was no evidence that VITs of the design tested in this study adversely affected reproductive performance. Wildlife biologists using VITs should recognize, however, that for the technique to be an effective aid in capturing newborn calves, transmitters need to be monitored daily, and search teams need to respond quickly when transmitters are shed because cow elk quickly move their calves from the birth site.

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