J Vet Clin 26(4) : 395-399 (2009)

Journal of Veterinary Clinics
www.ksvc.or.kr

Surgical Implantation of Intra-abdominal Radiotransmitter and Observation of Postoperative Behaviour in the River Otter (*Lutra lutra*) of Korea

Young-Ki Kim, Hee-Kyu Min, Yeung-Bae Jin, Sung-Kyu Lee**, Ki-Cheol Oh**, Jong-Kab Kim*, Scott-S Lee, Hee-Chun Lee, Hong-Hee Chang, Hyo-Jong Lee and Seong-Chan Yeon[1]**

College of Veterinary Medicine, Gyeongsang National University, Jinju 660-701, Korea
**The Division of Forest Science, Gyeongsang National University, Jinju 660-701, Korea*
***The Nakdong River Basin Environmental Office, Changwon 641-722, Korea*

(Accepted : June 16, 2009)

Abstract : Radiotelemetry device was surgically implanted in the abdomen of a Eurasian river otter (*Lutra lutra*). Behaviors of the otter, hospitalized after surgical implantation were also observed. The surgical techniques involved an incision in the paralumbar fossa to introduce a radiotelemetry device into the abdominal cavity. Thirteen behaviors of the otter during hospitalization following abdominal surgery were observed and the time budget of each behavior and the times at which each behavior seems to appear most frequently were measured. This report could provide surgical techniques involving intra-abdominal implantation in otter and basic information associated with otter's behaviors during hospitalization.

Key words **:** behavior, Eurasian river otter, hospitalization, *Lutra lutra,* surgery.

Introduction

Whereas surgical implantations of radiotelemetry devices have been used to study the feasibility of reintroducing other species of otters (1,3-5,11), previous studies of otter behavior (2,6-9,12) did not report the behavior of otters during hospitalization following abdominal surgery.

This case report describes the postoperative behaviors of a hospitalized river otter from the day after surgical implantation of radiotelemetry devices through a paralumbar fossa incision to the day of the release.

Case

A male adult otter weighing 7.63 kg was live trapped with leg-hold traps and transported to Gyeongsang National University, College of Veterinary Medicine. The otter was handled according to the Laboratory Animal Control Guidelines of Gyeonsang National University, which are based on the Guide for the Care and Use of Laboratory Animals of the US National Institutes of Health. The otter was fasted for approximately 6 hours prior to surgery but was allowed access to drinking water. It was chemically immobilized with ketamine hydrochloride (Yuhan Ketamine, Yuhan Co., Seoul, Korea; 15 mg/kg IM) and diazepam (Melode, Dong Wha Pharm Co., Seoul, Korea; 0.5 mg/kg IM) for restraint. On physical and radiographic examinations, there were no clinical abnormalities. After the clinical examinations, the otter was intubated with an endotracheal tube 4.0-mm in diameter. Anesthesia was maintained with isoflurane (Terrell, Minrad, Inc., New York, U.S.A.) and oxygen through a rebreathing system at a rate of 1.5 L/min. Respiratory rates (mean rate ± SD = 28.7 ± 4.1/min) and rectal body temperature (mean temperature ± SD = 39.6 ± 1.6°C) of immobilized otter were monitored with a patient monitor (UM-P400, Union Medical Co., Uijeongbu, Korea). Lactated Ringer's solution was administered through the cephalic vein at 10 ml/kg/hr. The otter was then placed in right lateral recumbence to expose paralumbar fossa. A surgical area (0.5 × 2-3 cm) cranial to the quadriceps muscles of the hind limb was clipped and aseptically prepared with chlohexidine jelly (Silgreen cream, Sung Kwang Pharm Co., Bucheon, Korea), povidone iodine scrub, and 70% ethyl alcohol washes (Fig 1). Then, the surgical area was draped with a four-corner draping technique. A 2 - 3 cm dorsoventral skin incision was made in the surgical area and the cutaneous trunci muscle was sharply transected. Then the external abdominal oblique, internal abdominal oblique and transverse abdominal paralumbalis muscles were sequentially transected. Deep to the abdominal muscles, the transverse fascia and peritoneum were lifted up with thumb forceps and carefully incised to give access to the peritoneal cavity. When the peritoneal cavity was opened, a radiotelemetry device (M1230, Advanced Telemetry Systems, Inc., Isanti MN, U.S.A.; 7 × 1.8 cm in size; 22 g in weight) which was sterilized by ethylene oxide gas and washed with sterile saline was

[1]Corresponding author.
E-mail : scyeon@gnu.ac.kr

Fig 1. The fur in the surgical area was clipped in the shape of "1" 0.5 cm × 2-3 cm long.

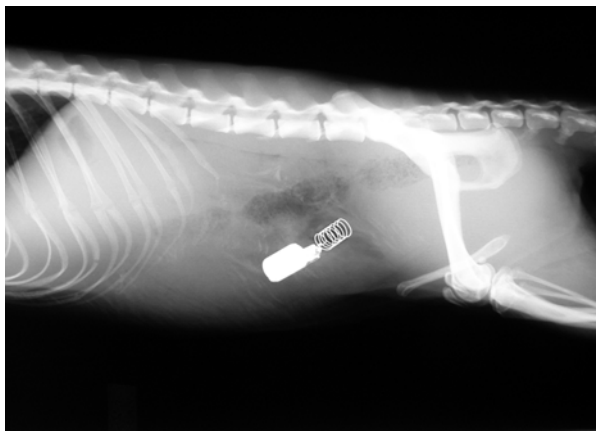

Fig 3. Lateral abdominal radiograph illustrating the position and orientation of a surgically implanted radiotelemetry device.

inserted and allowed to float freely in the abdominal cavity (Fig 2). In case of hemorrhage, a surgical radio-cautery was used for hemostasis. The abdominal cavity and musculature were sutured with 3-0 polydioxane (PDS II, Johnson & Johnson Medical N.V., Dilbeek, Belgium) in a simple continuous pattern, and subcutaneous tissue was apposed with 3-0 polydioxane in a simple interrupted pattern. Polydioxane suture material was also used in an intradermal suture pattern to appose the skin. Finally, surgical glue (Vetbond, 3M Health care products, Minnesota, USA) was used to appose the skin. According to postoperative radiographs, the radiotelemetry devices settled well in the abdomens (Fig 3).

After recovering from anesthesia, the otter was maintained in a 2.8 × 5.8 m room that was illuminated naturally and included rocks and three rubber nests (80 × 80, 60 × 60 and 80 × 45 cm), each of which was filled with sand, a rock, and dead leaves. The otter was supplied with drinking water and food which was a mixture of living and freshly killed minnow at 09:00 hour - 10:00 hour and 18:00 hour - 20:00 hour. Video recordings of a postoperative otter were conducted during 183 hours (7.5 days) which is from a day after surgery to a day of the release. Three DSP day and night cameras (CCN-432LA, Unimo Technology Co., Seoul, Korea) and one color CCD camera (SDC-411, Samsung Electronics Co., Seoul, Korea) were used. In order to combine these four visual effects for unilateral transmission, one digital multiplexer (SDM-090, Samsung Electronics Co., Seoul, Korea) and time lapse VCR (Samsung Electronics Co., Seoul, Korea) were used. The otter's behaviors were measured by scan sampling at intervals of two minutes.

Thirteen behaviors were observed during postoperative hospitalization, which were classified into seven behavioral categories as indicated in the Table 1. The percentage of the time otter used to show different types of behavior while hospitalized were as follows: 2.5% in 'Grooming' (RR 1.8%, SG 0.7%), 1.2% in 'Ingesting' (EA 0.3%, DR 0.9%), 2.4% in 'Movement' (FM 0.7%, SM 1.7%), 8.4% in 'Trying to escape' (ES 2.8%, JW 1.1%, LK 4.5%), 2.5% in 'Alerting' (LA 2.0%, HI 0.5%), 0.6% in 'Defecation'(DE) and 82.5% in 'Rest' (RN) (Fig 4).

The times at which each behavior seems to appear most frequently were as follows: 'Grooming' at 11:00 hour (10.8%),

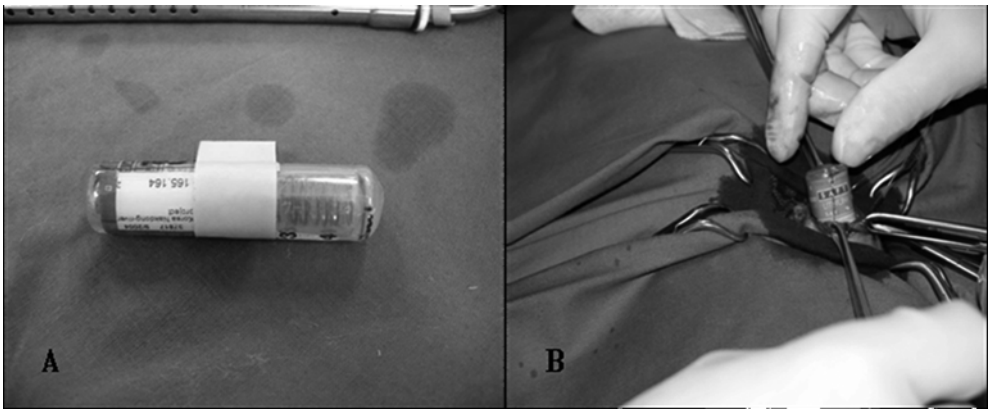

Fig 2. (A) Radiotelemetry device used for abdominal implantation in river otter. (B) The insertion of a radiotelemetry device into the surgical site.

Table 1. The list of behavioral classification

Behavioral categories	Definitions of observed behaviors	Initial word
Grooming	Rolling and rubbing on the rock, ground, or corner of the nest.	RR
	Self-grooming while lifting one of its leg and licking its genital organ and bend its body for licking other parts of body.	SG
Ingesting	Eating.	EA
	Drinking water.	DR
Movement	Fast movement, without hesitation, moving in unilateral direction.	FM
	Slow movement, without hesitation, moving in unilateral direction.	SM
Trying to escape	Exploration of recovery room and search for an escape route by frequent movement.	ES
	Jumping onto the window.	JW
	The position of the body is fixed and looking for detection of potential dangers.	LK
Alerting	Looking around for detection of potential danger in the nest.	LA
	Hiding after seeing a person bringing its food.	HI
Defecation	Defecating while lifting its tail and resting its hip on the ground.	DE
Rest	Resting in the nest. However, whether sleeping or doing other activities were not clear.	RN

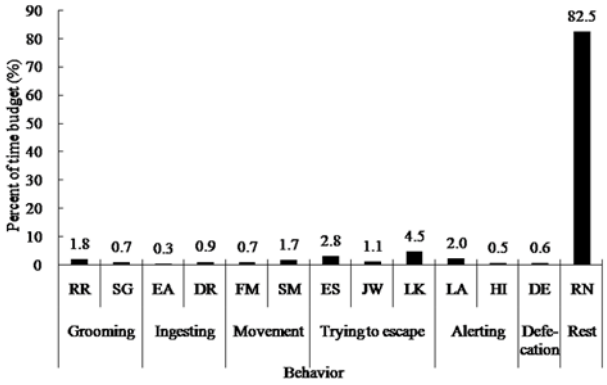

Fig 4. Mean for time budget of each behavior while hospitalized. RR: rolling and rubbing. SG: self-grooming. EA: eating. DR: drinking. FM: fast movement. SM: slow movement. ES: searching for an escaping route. JW: jumping onto the window. LK: looking for detection of potential dangers. LA: looking around in the nest. HI: hiding. DE: defecation. RN: resting in the nest.

19:00 hour (10.0%) and 03:00 hour (11.7%), 'Ingesting' at 10:00 hour (2.9%) and 19:00 hour (4.7%), 'Movement' at 09:00 hour (7.1%), 21:00 hour (6.2%) and 05:00 hour (8.3%), 'Trying to escape' at 09:00 hour (30.4%) and 05:00 hour (26.7%), 'Defecation' at 07:00 hour (1.7%), 03:00 hour (2.1%) and 05:00 hour (1.7%), 'Alerting' at 19:00 hour (11.4%) and 22:00 hour (8.6%). Time at which 'Rest' seems to appear most frequently was at the hours between 15:00 hour and 17:00 hour (99% - 99.5%) and between 01:00 hour and 02:00 hour (97.9% - 97.9%) and least frequent at 05:00 hour (57.1%) and 09:00 hour (53.3%) (Fig 5).

Discussion

Since otters frequently rub themselves during grooming by sliding the ventral portion of their bodies against vegetation in the wild or towels in captivity, some authors recommended the paralumbar fossa approach when implanting intra-abdominal radiotelemetry devices (3,10). The main disadvantage of using a surgical approach through the paralumbar fossa is the need to transect a group of large muscles. Unlike previous surgical techniques (1,3-5,11), which included midventral and lateral approach, the radiotelemetry device used in this case was implanted with minimal exposure. Although transections of various layers of muscles were necessary, no specific problems occurred. In addition, no healing problems occurred although the otter involved in this case also rolled and rubbed its paralumbar fossa region, incision site, against rocks and corners of nest. According to the behavioral observations that are performed from a day after surgery to a day of the release, this behavior was not detected for first two days of postoperative hospitalization but showed 1% on the third day and the highest (5.8%) on the fifth day.

Previous studies (1,2) reported that otters began to eat in captivity after between 2 - 5 days and some otters tried to escape during the first two to three nights of captivity. In this case, no EA were also detected for the first two days but showed 0.3% on the third day and highest (0.6%) on the fifth day. As for 'Trying to escape', it was 5.8% on the first day but increased to 16.7% on the sixth day.

'Rest' (82.5%) was the most frequently observed behavior in a postoperative hospitalized otter. It started at 85.4% on the first day and gradually decreased to 74.3% on the sixth day. In a previous study (7), the behavior of captive sea otter was divided into 4 distinct stages: active wakefulness (40.5 - 50.5% of 24 hour), quiet wakefulness (21.5 - 30.8%), quiet sleep (23.9 - 35.0%), and paradoxical sleep (1.1 - 2.5%). But in this case, although 'Rest' indicated that otter was resting in the nest, where it could not be determined whether the otter was sleeping or performing other behaviors in the nest. Sim-

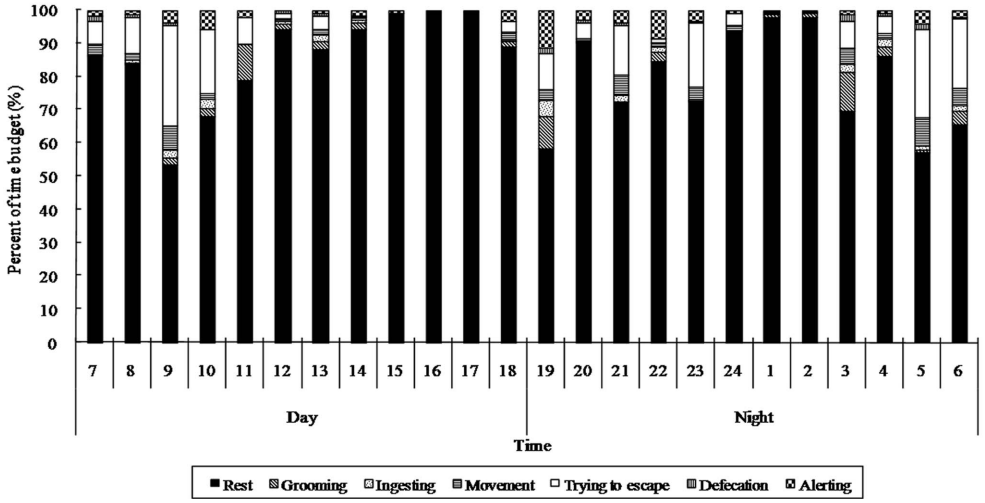

Fig 5. Percent of time budget in each behavior throughout the day. The value presented for each behavior at each time of day is the mean of data during postoperative hospitalization.

ilar with the previous study (1) which reported that otters in captivity spent most of their time inside the wooden nests, except at night, 'Rest' was most frequently observed during the day especially between the hours of 15:00 (99%) to 17:00 (99.5%) whereas least frequently observed at the hour of 05:00 (57.1%) and 09:00 (53.3%). Following 'Rest', 'Trying to escape' was detected most frequently. This behavior includes sniffing for danger, detecting exits, jumping onto the window and attempting to escape and these behaviors were most frequently observed at the hour of 05:00 (26.7%) and 09:00 (30.4%). Therefore, it was indicated that the otter spent its afternoon resting in the nest. In addition, during dawn and early morning, the otter was active in the recovery room, detecting for changes, looking for exits and attempting to escape. As time progressed, 'Rest' was shown less frequently whereas 'Trying to escape' was shown as the animal spent more time apparently looking for an escaping route. Therefore, it seems like the otter observed was adapting to the environment of the recovery room and pursuing its desire to escape.

Three different nests were provided for the otter. Rather than having a preference single for a specific nest, the otter was using all three randomly.

River otters have prominent terrestrial sites at specific locations throughout their home range. At these sites, known as latrines, otters deposit feces, urine and anal gland secretions (9). In this case, the postoperative hospitalized otter also deposited feces at specific sites. This behavior was observed mainly between 03:00 hour and 09:00 hour and between 19:00 hour and 21:00 hour.

In this case, thirteen behaviors of one otter during hospitalization following abdominal surgery were observed and the time budget of each behavior and the times at which each behavior seems to appear most frequently were measured. However, it is difficult to confirm the behavior patterns of postoperative hospitalized otter with these data because this study has limited sample size owing to legal restriction on capturing endangered otters. The behavioral study of postoperative hospitalized otters should be continued to reduce otter's stress during hospitalization and to obtain their successful release. This case report could provide basic information for the further studies involving otter's behavior. Also, we hope that this study contributes veterinarians and scientists to research otter's behavior, and helps them not to experience a process of trial and error.

Acknowledgements

The authors would like to thank Dr. Katherine A Houpt (Cornell University) for her constructive comments on this manuscript. This work was supported by grant No. R21-2005-000-10002-0 from MOST (KOSEF).

References

1. Fernandez-Moran J, Saavedra D, Manteca-Vilanova X. Reintroduction of the Eurasian otter (Lutra lutra) in northeastern Spain: trapping, handling, and medical manage ment. J Zoo Wildl Med 2002; 33: 222-227.
2. Fernandez-Moran J, Saavedra D, De La Torre J, Manteca-Vilanova X. Stress in wild-caught Eurasian otters (Lutra lutra): effects of a long-acting neuroleptic and time in captivity. Anim Welf 2004; 13: 143-149.
3. Hernandez-Divers SM, Kollias GV, Abou-Madi N, Hartup BK. Surgical technique for intra-abdominal radiotransmitter placement in North American river otters (Lontra canadensis). J Zoo Wildl Med 2001; 32: 202-205.
4. Hoover J. Surgical implantation of radiotelemetry devices in American river otters. J Am Vet Med Assoc 1984; 185: 1317-1320.
5. Hoover J, Bahr R, Nieves M, Doyle R, Zimmer M, Lauzon S. Clinical evaluation and prerelease management of American

river otters in the second year of a reintroduction study. J Am Vet Med Assoc 1985; 187: 1154-1161.
6. Londono G, Munoz N. Reproduction, behaviour and biology of the Giant river otter Pteronura brasiliensis at Cali Zoo. Int Zoo Yb 2006; 40: 360-371.
7. Lyamin O, Oleksenko A, Sevostiyanov V, Nazarenko E, Mukhametov L. Behavioral sleep in captive sea otters. Aquat Mamm 2000; 26: 132-136.
8. Nolet B, Kruuk H. Grooming and resting of otters Lutra lutra in a marine habitat. J Zool 1989; 218: 433-440.
9. Rostain R, Ben-David M, Groves P, Randall J. Why do river otters scent-mark? An experimental test of several hypotheses. Anim Behav 2004; 68: 703-711.
10. Serfass T, Peper R, Whary M, Brooks R. River otter (Lutra canadensis) reintroduction in Pennsylvania: prerelease care and clinical evaluation. J Zoo Wildl Med 1993; 24: 28-40.
11. Spelman L, Jochem W, Summer P, Redmond D, Stoskopf M. Postanesthetic monitoring of core body temperature using telemetry in North American river otters (Lutra canadensis). J Zoo Wildl Med 1997; 28: 413-417.
12. Stevens S, Serfass T. Sliding Behavior in Nearctic River Otters: Locomotion or Play? Northeast Nat 2005; 12: 241-244.

수달의 복강 내 무선추적 전파발신기의 이식과 수술 후 행동 관찰

김영기 · 민희규 · 진영배 · 이성규** · 오기철** · 김종갑* · 이스캇 · 이희천 · 장홍희 · 이효종 · 연성찬**[1]**

경상대학교 수의과대학 · *경상대학교 농과대학 · **낙동강 환경유역청

요 약 : 한국 수달의 복강 내에 무선추적 전파발신기를 수술적으로 이식하였으며 수술 후 입원해 있는 기간 동안 수달의 술 후 행동을 관찰하였다. 복강 내로 전파발신기를 삽입하기 위해 옆구리 오목 부위를 절개하여 접근하였다. 복강 수술 후 입원해 있는 기간 동안 13가지의 행동이 관찰 되었으며 입원기간 동안 각 행동이 보여지는 비율과 각 행동이 가장 빈번히 관찰되는 시간을 측정하였다. 본 연구는 수달에서 복강 내 이식물을 삽입하기 위한 수술적 기술을 제공하고 입원해 있는 동안의 수달 행동에 관한 기초적 정보를 제공할 수 있을 것이다.

주요어 : 행동, 유라시안 수달, 입원, 수술.