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Evaluation of two techniques for attaching radio transmitters to turkey poults

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ABSTRACT. We conducted a pen study to evaluate two methods of attaching radio transmitters to Wild Turkey (*Meleagris gallopavo*) poults. Transmitters (1.8 g) were attached interscapularly to 2-d-old turkeys, either with glue or as implants. Attachment method had no detectable effect on the growth or survival of poults. Transmitter retention differed between the methods. Mean retention times were 27.6 d for glued backpacks and 30.5 d for interscapular implants. Ease of implementation and behavioral differences of birds immediately after application suggest that glued backpacks are preferred in situations where a retention time of 29 d is adequate.

SINOPSIS. **Evaluación de dos técnicas para colocar radiotrasmisores a polluelos de pavos**
Se condujo un estudio en cautiverio para evaluar dos métodos de colocarles radiotrasmisores a polluelos de pavos (*Meleagris gallopavo*). Trasmisores de 1.8 g se le colocaron interescapularmente, implantados o con pega, a pavitos de un día de edad. No se detectó efecto sobre el crecimiento o supervivencia de los polluelos entre ambos métodos. Sin embargo, hubo diferencias en la retención del transmisor. El tiempo promedio de retención fue de 27.6 días para los pegados y de 30.5 días para los implantados. La facilidad de implantación y las diferencias en la conducta de las aves, inmediatamente después de la aplicación, sugiere que los transmisores pegados deben preferirse en situaciones en donde la retención por 29 días,se considere.

Key words: growth, implant, *Meleagris*, survival, telemetry, transmitter attachment, Wild Turkey

Survival rate estimates of neonatal birds are an important component of population models; however, these rates have rarely been accurately assessed. Young, growing birds are difficult to monitor effectively, especially without affecting physical development (Hubbard et al. 1998).

Early efforts to radio-track young or small birds involved the use of harnesses (Graber and Wunderle 1966; Godfrey 1970), tail clips (Bray et al. 1975), or glue that was expected to last 2 to 3 d (Graber 1965). Raim (1978) improved on the glue technique, but could give only a rough estimate of transmitter retention times (average 10 to 14 d). Mauser and Jarvis (1991) modified the glue attachment method to improve tag retention by adding a subcutaneous anchor. Most recently, techniques have been developed to surgically implant transmitters into the abdomen (Korschgen et al. 1984) or interscapularly (Korschgen et al. 1996).

Although these techniques have been developed for attaching radio transmitters to young birds, there are few data about transmitter effects on growth and survival. Accurate estimates of transmitter retention times also are lacking. However, captive birds can be used to provide accurate and precise estimates of retention times or growth and survival effects for various transmitter attachment techniques. Hubbard et al. (1998) recently studied the effects of interscapular implants (Korschgen et al. 1996) and harnesses on captive Wild Turkey poults (*Meleagris gallopavo*). Hubbard et al. (1998) found that harnesses did not break as expected when birds grew, and consequently wing growth was affected and the birds were prevented from flying. The authors suggested that this may have been the cause of high poult mortality rates reported in previous studies of Wild Turkeys, as these studies had used harness attachments

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(e.g., Speake et al. 1985; Peoples et al. 1995). Hubbard et al. (1998) preferred the implant technique, but did not report survival rates or transmitter retention rates, although good retention can be inferred from their analysis-of-variance results.

Prior to initiating a field study of Rio Grande Wild Turkey (*M. g. intermedius*) poult survival in the rolling plains of Texas and Kansas, we conducted a captive study to assess methods of attaching radio transmitters to turkey poults. The objectives of our study were to measure the effects on growth and survival, and to determine transmitter retention times of two attachment methods: glued backpacks and interscapular implants.

METHODS

Dummy versions of model 384 implantable transmitters ($N = 40$) were obtained from Advanced Telemetry Systems (Isanti, Minnesota). The transmitters were encased in a biologically inert epoxy resin (3M Scotchcast®) and weighed 1.8 g. Transmitter dimensions were 10.5 mm × 20 mm × 4 mm, with rounded edges on all sides. Antenna length was 10 cm.

We used domestic turkeys as model animals for the study; 1-d-old bronze poults were obtained from a commercial source. Transmitters were attached on the second day after hatching when birds were 55–61 g. The transmitters were approximately 3% of poult mass at the time of attachment. We chose to assess transmitter attachment by a modification of the glued backpack (Raim 1978) and by a modification of the interscapular surgical implant (Korschgen et al. 1996). Harnesses were clearly demonstrated by Hubbard et al. (1998) to be flawed for use on turkey poults, so we felt it unnecessary to include harnesses in our study. Hubbard et al. (1998) recommended using interscapular implants; we wanted to compare implants to glued backpacks, which were not considered by Hubbard et al. (1998), but which have been used with success in other studies (Raim 1978; Sykes et al. 1990).

Turkeys were initially divided into three treatment groups: (1) control (no transmitter; $N = 28$); (2) glued ($N = 20$); and (3) implanted ($N = 20$). Individual birds were identified with colored leg bands. Attachment of glued transmitters followed Raim's (1978) protocol with a few exceptions. The interscapular site of attachment was shaved to bare skin with an electric razor. The underside of the transmitter was roughened with sandpaper to improve cohesion. Between four and six drops of Krazy Glue®, an ethyl cyanoacrylate, was applied to the shaven area and an equivalent amount was applied to the roughened transmitter surface. A small piece of cheese cloth, about the same size as the ventral surface of the transmitter, was applied to the glued skin and the transmitter was applied to the cheese cloth. No sutures were used. The procedure took < 5 min per bird.

The implantation of transmitters followed the modifications to the method of Korschgen et al. (1996) by Hubbard et al. (1998). In particular, poults were not anesthetized during surgery. We departed from Hubbard et al. (1998) in that incisions were closed with surgical glue instead of sutures. The implantation procedure took < 10 min per bird.

Birds from the three treatment groups were mixed randomly into six pens (4 m^2 each; either 11 or 12 birds per pen), supplied with infrared heat lamps, fed commercially prepared starter feed, and watered *ad libitum*. Birds were weighed at 4-d intervals, and following the suggestion of Hubbard et al. (1998), we assessed wing growth during the same intervals by measuring ulna length. Survival and condition of birds and retention of transmitters also were assessed at 4-d intervals. All aspects of this research were approved by the Texas Tech University Animal Care and Use Committee (Protocol 99919).

Differences in individual growth rates were assessed by comparing masses and wing lengths among groups. We compared groups using repeated-measures analysis of variance. Survival estimates for birds in each of the treatments were calculated using Kaplan-Meier procedures (Kaplan and Meier 1958) and compared using log-rank analysis. Birds were censored for this analysis in the event of transmitter loss or when the study was terminated. Finally, we calculated Kaplan-Meier survival estimates for retained transmitters, treating lost transmitters as deaths. This calculation was made to compare the retention rates of the two attachment methods. Transmitters were censored if a bird carrying a transmitter died prior to the termination of the study or if the transmitter remained attached

Table 1. Mass of domestic turkey poults in a pen study of radio transmitter attachment techniques conducted during spring 2000 at Texas Tech University. Treatments included a control group, an interscapular-implant group, and a glued-backpack group. Masses (g) are listed along with 95% confidence intervals and sample sizes in parentheses.

Age in days	Control	Glue	Implant
2	59 (57–61) (28)	59 (58–60) (20)	57 (55–59) (20)
6	109 (105–113) (26)	114 (110–118) (18)	110 (107–114) (19)
10	164 (158–171) (25)	175 (168–182) (18)	172 (168–177) (17)
14	293 (275–311) (25)	313 (303–324) (18)	298 (272–325) (17)
18	376 (350–402) (25)	407 (391–423) (17)	381 (350–403) (17)
22	528 (481–576) (24)	574 (551–596) (17)	526 (435–618) (12)
26	708 (643–772) (22)	740 (703–777) (15)	677 (530–824) (11)
30	904 (835–974) (21)	922 (877–966) (11)	889 (741–1036) (10)

when the study was terminated. Statistical analyses were carried out using S-Plus 2000 (Insightful Corporation, Seattle, WA.).

RESULTS

There was a difference in the condition of the birds immediately after surgery. Birds in the glued-backpack group behaved like control birds, exhibiting no ill effects of handling or of carrying transmitters. However, implanted birds had difficulty maintaining balance and walked with apparent difficulty. This condition persisted for 2–4 h. By 24 h after surgery there were

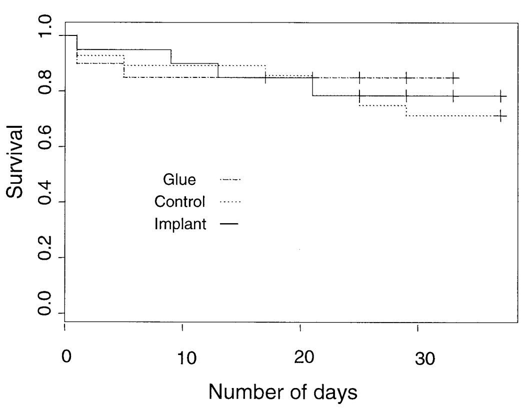

Fig. 1. Kaplan-Meier survival estimates for domestic turkey poults stratified into three treatment groups based on radio transmitter attachment methods: glued backpacks, interscapular implants, and a control group (no transmitter). Survival curves were not significantly different ($\chi^2_2 = 0.9$, $P = 0.65$). Censored events, where individuals were removed from analysis, are indicated by (+).

no notable differences in behavior among the groups.

We detected no significant differences in either body mass ($F_{2,41} = 1.22$, $P = 0.32$) or wing length ($F_{2,41} = 1.15$, $P = 0.38$) between birds at any interval (Table 1). Five birds exhibited a slipped tendon in a knee joint possibly as a result of nutrient imbalance (a condition unrelated to transmitter attachment), and these birds were unevenly distributed across the groups (none in the glued group). Slipped-tendon birds were small; consequently, 95% confidence intervals for the mean mass of the glued group are narrower than for the other groups (Table 1).

Log-rank analysis demonstrated no difference in survival among birds in the three treatment groups ($\chi^2_2 = 0.9$, $P = 0.647$; Fig. 1). Median survival was greater than the duration of the study (37 d) for all three groups. A total of 13 birds (six control, four implant, three glue) died during the study. Some of these (two control, one implant, three glue) died during the first two days of the study. The other mortalities were birds that exhibited slipped tendons. These birds had difficulty feeding as a result of their condition.

A second log-rank analysis demonstrated that there was a significant difference in transmitter retention times for the two attachment methods ($\chi^2_1 = 6.5$, $P = 0.011$; Fig. 2). Median retention of glued transmitters was 29 d (95% confidence interval = 25–29 d), whereas median retention of implanted transmitters was greater than the 37-d duration of the study. The mean ± SE retention of glued transmitters

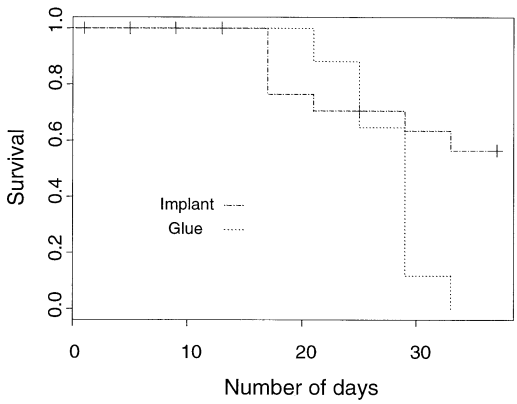

Fig. 2. Kaplan-Meier survival estimates for radio transmitters attached to domestic turkey poults. Transmitters that were retained by poults were considered alive, in order to assess transmitter retention times. Transmitters that were shed were equivalent to mortality. The two attachment methods were glued backpacks and interscapular implants. Survival curves for transmitter attachment were significantly different (χ^2_1 = 6.5, P = 0.01). Censored events, where individuals were removed from analysis, are indicated by (+).

was 27.6 ± 0.8 d, whereas for implanted transmitters it was 30.5 ± 2.1 d.

DISCUSSION

The glued backpack and the interscapular implant methods of attaching radio transmitters to turkey poults had no detectable effects on bird growth. Hubbard et al. (1998) found that a harness backpack attachment caused wing edema because the harnesses did not break as intended. This wing edema interfered with flying and may have contributed to high mortality rates detected in previous studies of poults with harnessed transmitters (Speake et al. 1985; Peoples et al. 1995). Other authors have demonstrated that harnesses can have negative effects on bird behavior (Sykes et al. 1990; Rotella et al. 1993; Dzus and Clark 1996; Paquette et al. 1997). We observed no effects on bird growth, behavior, or survival using the attachment methods in our study, with one exception. Immediately following surgery, and for an interval of > 1 h, poults exhibited an impaired response to implantation. This response involved difficulty maintaining balance and moving about the pen. Hubbard et al. (1998) mentioned no such impairment and observed this response only rarely (M. W. Hubbard, pers. comm.). Mauser and Jarvis (1991) noted that pen-reared Mallard (*Anas platyrhynchos*) ducklings exhibited similar impaired behavior following glue-and-anchor implantation. Our implantation method differed from Hubbard et al. (1998) in that we used a 1.8-g transmitter instead of a 1.5-g transmitter and we used surgical glue instead of sutures to close the incision. It is possible that either of these changes could have contributed to the post-surgery behavioral effects that we observed.

A major difference between the two attachment methods was in transmitter retention (Fig. 2). Implanted transmitters exhibited a somewhat gradual, consistent rate of loss, whereas glued transmitters were retained by most birds up to about 29 d, at which point most transmitters were lost within a single 4-d measurement interval. Glued transmitters performed better than expected, far exceeding the rates mentioned by Raim (1978) and Sykes et al. (1990). Neither of these authors used cyanoacrylate glues as the primary adhesive, suggesting instead that cyanoacrylates may be histotoxic (Woodward et al. 1965). However, cyanoacrylates have been widely used in other studies (Mauser and Jarvis 1991; Wheeler 1991; Rotella et al. 1993), and we observed no adverse effects resulting from the glue.

Retention of implanted transmitters was poorer than expected. Implanted transmitters seemed to be extruded during the growth process. Sutures may have improved retention of implanted transmitters, although a number of investigators, including some who have used sutures, have also observed transmitters to be extruded (Zimmer 1997; Mulcahy et al. 1999; M. W. Hubbard, pers. comm.). In our study, extrusion was caused by necrosis of the skin layer above the implant. Although the necrosis may have been associated with our choice of transmitters, this explanation seems unlikely as our transmitters were lower in profile (4.0 mm high) than the transmitters used by both Korschgen et al. (1996) and Hubbard et al. (1998) (5.0 mm high). We are unsure what caused the necrosis.

Both methods of attaching transmitters have advantages and disadvantages for studying Wild Turkey poult survival. Glued transmitters are easy to attach and the method requires minimal training. However, retention time is relatively short (median, 29 d). Where this retention time is adequate for study objectives, we recommend the glued-backpack method. Implanted transmitters offer the potential of greater retention times. However, implantation involves more training and more time to implement. Also, the impaired post-surgical response could be problematic in studies where young birds are to be replaced with their brood immediately following transmitter attachment.

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