Western North American Naturalist

Volume 63 | Number 1 Article 19

1-31-2003

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Western North American Naturalist 63(1), ©2003, pp. 133–135

EVALUATION OF SERUM GAMMA GLOBULIN CONCENTRATIONS IN NEONATAL PRONGHORN IN OREGON

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Key words: antelope, Antilocapra americana, *failure of passive transfer, gamma globulin, immunoglobulins, nutrition, pronghorn.*

Because placental transfer of maternal immunoglobulins to the fetus is minimal (Hartsook et al. 1975), mammalian neonates acquire important immune protection through passive transfer of maternal antibodies in colostrum, usually within the first 24 hours after birth (Tizard 1977). Without this absorption (i.e., failure of passive transfer, FPT), the concentration of plasma immunoglobulin in the neonate is low, and prevalence and severity of diarrhea, septicemia, or pneumonia are greatly increased (McEwan et al. 1970, Logan and Penhale 1971, McGuire et al. 1976, Sawyer et al. 1977), possibly resulting in direct mortality or predisposition of neonates to predation or other causes of mortality. Poor maternal nutrition, due to malnourishment, may affect passive transfer of immunoglobulins through delayed lactation (Verme 1962, Murphy and Coates 1966) and also may result in a decrease in production of immunoglobulins by the dam (Parkinson et al. 1982). A high incidence of FPT could be indicative of poor adult female condition and overall poor population condition.

A health evaluation was conducted on the pronghorn (*Antilocapra americana*) population on Hart Mountain National Antelope Refuge (HMNAR) located in southeastern Oregon (42°30′N, 119°40′W) in 1996 and 1997 (Dunbar et al. 1999) because fawn survival was poor. However, determination of the potential occurrence of failure, or partial failure, in the passive transfer of immunity from maternal colostrum was not conducted. These data could provide further information on condition of neonates and their dams.

My objective was to determine the potential occurrence of FPT of immunoglobulins in 1- to 3-day-old pronghorn on HMNAR by comparing gamma globulin (GG) concentrations with reported data from other neonatal ungulates, including pronghorn. I compared data with those in other studies that used the same techniques I used in this study for determining concentrations of protein fractions. Parkinson et al. (1982) and Stickle et al. (1994) believe the use of GG to be a reasonable technique for estimating levels of passive immunity from maternal colostrum because a large portion of the gamma fraction is immunoglobulin. I also report concentrations of total protein (TP) and other protein fractions for reference. This is the first known published study to evaluate FPT in neonatal pronghorn.

During May 1996 blood was collected from 52 free-ranging, 1- to 4-day-old pronghorns on HMNAR as part of a study conducted by Dunbar et al. (1999). From those samples, twenty-seven 1- to 3-day-old pronghorn were randomly selected to determine serum concentrations of TP and protein fractions, including albumin, alpha 1 and 2, beta 1 and 2, and GG. Age of neonates was estimated with behavioral criteria and condition of pelage, umbilical cord, and hooves (Von Gunten 1978, Trainer et al. 1983).

Concentrations of TP and protein fractions were determined by the Clinical Pathology Laboratory, Veterinary Medical Teaching Hospital, School of Veterinary Medicine, University of Wisconsin, Madison. Concentrations of TP were determined with a refractometer (Leica, Buffalo, NY). Albumin, alpha 1 and 2, beta 1 and 2, and GG fractions, reported as the percentage of TP, were determined with a Corning Electrophoresis Chamber (Corning Medical

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and Scientific, Corning Glass Works, Palo Alto, CA) using universal electrophoresis gel (Helena Labs, Beaumont, TX) and standard procedures (Barta 1993). The value of each fraction ($g \cdot dL^{-1}$) was calculated by multiplying its percentage by the TP value for each neonate.

I used 1-way analysis of variance (ANOVA; SAS 1998) to test for differences in TP and protein fractions between age-classes (1-, 2-, and 3-day-old) of pronghorn. A 2-tailed *t* test, also in SAS, was used to compare mean GG levels from my study with those of neonatal pronghorn captured in Alberta, Canada (Barrett and Chalmers 1979). Significance was set at $P < 0.05$.

Mean ± *s* levels were determined for TP (4.8 ± 0.5 g · dL^{-1}), albumin (2.6 ± 0.3 g · dL^{-1}), alpha 1 and 2 (0.6 ± 0.3 g · dL^{-1}), beta 1 and 2 (1.3 ± 0.6 g · dL^{-1}), and GG (0.30 ± 0.13 g · dL^{-1}). I found no differences ($P \geq 0.05$) among age-classes for any parameter.

Barrett and Chalmers (1979) captured forty-six 4- to 10-day-old pronghorn in Alberta, Canada, and found mean ± $s_{\bar{x}}$ GG values of 1.13 ± 0.07 g · dL^{-1}. Compared with pronghorn in this study, there was a difference ($P \leq 0.001$) between GG values.

Mean values of GG in neonates in my study were similar to those found in 3 of 6 species of nonviable, 1- to 2-day-old, nondomestic ungulates (range, 0.2– 2.95 g · dL^{-1}) in a study by Stickle et al. (1994) in which FPT may have contributed to their death.

Parkinson et al. (1982) conducted a study of captive 2- to 7-day-old mule deer (*Odocoileus hemionus*) and found GG concentrations of 0.66 g · dL^{-1} in neonates that became sick and died, possibly a result of FPT. In comparison, the survivors had GG concentrations of 1.51 g · dL^{-1}. Also, Sams et al. (1996) reported that the mean GG concentration in a controlled study of 1- to 3-day-old white-tailed deer (*O. virginianus*) was 1.13 g · dL^{-1} in those that survived compared with 0.92 g · dL^{-1} in those that died, due apparently to FPT. GG concentrations in neonates in my study were lower than GG values from neonatal pronghorn in a Canadian study (Barrett and Chalmers 1979) and from nonsurviving neonatal mule deer and white-tailed deer in studies by both Parkinson et al. (1982) and Sams et al.(1996).

In a study of horses, Blood et al. (1983) found that foals with serum immunoglobulin values <0.20 g · dL^{-1} are indicative of a failure of passive transfer, values of 0.20–0.40 g · dL^{-1} represent partial failure, and levels >0.40 g · dL^{-1} represent transfer. Compared with these values, neonates in my study may have had failure and partial failure of transfer.

In my study of 27 neonates, nearly 80% were lost to coyote (*Canis latrans*) predation and only 3 (11%) survived, at least until mid-July (2 months old; Dunbar et al. 1999). Three neonates from this study had low values of GG (range, 0.04–0.05 g · dL^{-1}), well below mean levels (0.30 ± 0.13 g · dL^{-1}). All 3 died of unknown causes, but evidence suggests predation by coyotes. One neonate that died of starvation at 4 days of age had 0.37 g · dL^{-1} GG at 1 day of age, which is within the mean ± *s* level of GG from this study. Three surviving neonates, however, sampled at 2 and 3 days of age, had GG levels of 0.34–0.36 g · dL^{-1}.

Based on these data, no relationship could be found between GG levels and cause of mortality, but illness due to FPT may predispose neonates to predation. Whether neonates in my study were predisposed to predation because of low GG values cannot be determined. Coyotes may have killed many of them before signs of disease could develop. However, all neonates were considered healthy upon capture, and none apparently died of disease (Dunbar et al. 1999). Therefore, incidence of FPT in neonates in this study is difficult to determine. The low GG values in this study may be normal for 1- to 3-day-old pronghorn.

The reason GG values of neonatal pronghorns in this study are low compared with other pronghorn and several species of other ungulates is not known. One plausible explanation for the differences between neonates in my study and those in the study by Barrett and Chalmers (1979) may be related to age. Neonatal pronghorn in the Canadian study were 4–10 days old compared to 1–3 days old in this study. Mammalian neonates may begin producing their own immunoglobulins at about 7 days of age. However, this does not explain the low GG values in my study compared with those in other neonatal ungulates of nearly the same age (1–7 days old) reported in deer (Parkinson et al. 1982, Sams et al. 1996) or with values in foals.

Assessing adequate passive transfer of immunoglobulins is a valuable component of the

health evaluation of free-ranging ungulates. A high incidence of FPT could suggest a population in poor condition and a management concern. Status of maternal nutrition, particularly during the last one-third of gestation, can adversely affect the passive process of transferring immunity from adult female to newborn (Belcha and Kelly 1981, Burton et al. 1984). Therefore, the low values of GG in my study may be indicative of poor condition of adult female pronghorns in this population. Although maternal nutrition of pronghorns from HMNAR has been evaluated during the winter (Dunbar et al. 1999), it has not been evaluated during parturition. No studies are planned to evaluate maternal nutrition during this critical time on HMNAR; however, studies are recommended.

This is the first known published study to attempt to evaluate FPT in neonatal pronghorn. Hopefully, data on serum concentrations of GG and other protein fractions in neonatal pronghorn provided in this study will serve to stimulate researchers to collect similar data on other pronghorn populations for comparison.

I thank the U.S. Fish and Wildlife Service for funding this study. Additionally, I thank the staff of the USFWS, Oregon Department of Fish and Wildlife, and the many volunteers who assisted in the study. I also thank M. Giordano for assistance with statistical analysis and review of the manuscript.

LITERATURE CITED

BARRETT, M.W., AND G.A. CHALMERS. 1979. Hematological and clinicochemical values for free-ranging pronghorn fawns. Canadian Journal of Zoology 57: 1757–1766.

BARTA, O., EDITOR. 1993. Veterinary clinical immunology laboratory: a monograph in animal immunology. Volume 2, pages c1-1–c1-17.

BELCHA, F., AND K.W. KELLY. 1981. Effects of cold and weaning stressors on the antibody-mediated immune response of pigs. Journal of Animal Science 53: 439–447.

BLOOD, D.C., O.M. RADOSTITS, AND J.A. HENDERSON. 1983. Veterinary medicine, a textbook of the diseases of cattle, sheep, pigs, goats and horses. 6th edition. Bailliere Tindall, Great Britain. 1310 pp.

BURTON, J.H., A.A. HOSEIN, I. MCMILLAN, D.G. GRIEVE, AND B.N. WILKIE. 1984. Immunoglobulin absorption in calves as influenced by dietary protein intakes of their dams. Canadian Journal of Animal Science 64:185–186.

DUNBAR, M.R., R. VELARDE, M.A. GREGG, AND M. BRAY. 1999. Health evaluation of a pronghorn antelope population in Oregon. Journal of Wildlife Diseases 35:496–510.

HARTSOOK, E.W., J.B. WHELAN, AND M.A. ONDIK. 1975. Changes in blood proteins of deer during gestation and suckling. Journal of Wildlife Management 39: 346–354.

LOGAN, E.F., AND W.J. PENHALE. 1971. Studies on the immunity of the calf to colibacillosis. Veterinary Record 88:222–228.

MCEWAN, A.D., E.W. FISHER, AND I.E. SELMAN. 1970. Observations on the immune globulin levels of neonatal calves and their relationship to disease. Journal of Comparative Pathology 80:259–265.

MCGUIRE, T.C., N.E. PFEIFFER, J.M. WEIKEL, AND R.C. BARTSCH. 1976. Failure of colostral immunoglobulin transfer in calves dying from infectious disease. Journal of the American Veterinary Medical Association 169:713–718.

MURPHY, D.A., AND J.A. COATES. 1966. Effects of dietary protein on deer. Transactions of the North American Wildlife and Natural Resources Conference 31: 129–139.

PARKINSON, D.E., R.P. ELLIS, AND L.D. LEWIS. 1982. Colostrum deficiency in mule deer fawns: identification, treatment and influence on neonatal mortality. Journal of Wildlife Diseases 18:17–28.

SAMS, M.G., R.L. LOCHMILLER, C.W. QUALLS, JR., D.M. LESLIE, JR., AND M.E. PAYTON. 1996. Physiological correlates of neonatal mortality in an overpopulated herd of white-tailed deer. Journal of Mammalogy 77:179–190.

SAS, INC. 1998. Statistical Analysis System 7.0. SAS Institute, Inc., Cary, NC.

SAWYER, M., C.H. WILLADSEN, B.I. OSBURN, AND T.C. MCGUIRE. 1977. Passive transfer of colostral immunoglobulins from ewe to lamb and its influence on neonatal lamb mortality. Journal of the American Veterinary Medical Association 171:1255–1259.

STICKLE, J.E., D.C. MILLER, AND A.H. LEWANDOWSKI. 1994. Serum protein fractions of viable and nonviable neonatal ungulates. Journal of Zoo and Wildlife Medicine 25:555–560.

TIZARD, I.R. 1977. An introduction to veterinary immunology. W.B. Saunders, Philadelphia, PA. 367 pp.

TRAINER, C.E., M.J. WILLIS, G.P. KEISTER, JR., AND D.P. SHEEHY. 1983. Fawn mortality and habitat use among pronghorn during spring and summer in southeastern Oregon, 1981–82. Wildlife Research Report 12. Oregon Department of Fish and Wildlife, Portland. 117 pp.

VERME, L.J. 1962. Mortality of white-tailed deer fawns in relation to nutrition. Proceedings of the National White-tailed Deer Disease Symposium 1:15–38.

VON GUNTEN, B.L. 1978. Pronghorn fawn mortality on the National Bison Range. Proceedings of the Pronghorn Antelope Workshop 8:394–416.

Received 17 July 2001
Accepted 18 March 2002