Influence of Diethylstilbestrol on Body Water Space in Ruminants[1] (34224)

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One of the earliest responses to diethylstilbestrol (DES) in growing ruminants is a decrease in plasma urea-N (1, 2). Several possible explanations were given for this response (1) which might relate to the growth response observed when this compound is given to growing cattle and sheep. Estrogens are known to increase water retention (3, 4) and plasma volume (4, 5) in nonruminants. The water content of tissues in rats increased during the first 18–36 hr of estradiol treatment, but returned to normal after this time (6, 7). It is known that the water content of tissues from lambs fed DES for 50–90 days is not altered when expressed on a fat-free basis (8).

The purpose of the present research was to determine if DES alters the body water space in lambs at the time when it causes maximum reduction in plasma urea-N (PUN).

Methods. Four wether lambs (av wt = 45 kg) were fed 1100 g/lamb/day of the cottonseed hull ration described previously (1). During the 24-day preliminary period, four blood samples (heparinized) were taken at 1 p.m. from each lamb for packed cell volume (PCV) and PUN determination. At the end of this period, the lambs were paired, based on PUN values, and one lamb in each pair was implanted with 3 mg of DES.[2] During the experimental period, which lasted 27 days, eight blood samples (heparinized) were taken at 1 p.m. from each lamb for PCV and PUN determinations. On day 12 of this period, each lamb was injected with approximately 0.8 mCi of TOH[3] into the jugular vein. Six blood samples were taken from each lamb over the remaining 14 days and were used to determine body water space, water turnover rate, PUN, and PCV.

The PUN and PCV were determined as previously described (1). Tritium activity was determined in plasma trichloroacetic acid (TCA) filtrates similar to procedures outlined by Langham *et al.* (9). Twenty ml of scintillation fluid (containing 7.7 ml of dioxane and toluene, 4.6 ml of absolute methanol, 1.6 g of naphthalene, 100 mg of 2,5-diphenyloxazole, and 2 mg of 1,4,-bis-2-(5-phenyloxazolyl)-benzene) and 0.5 ml of plasma TCA filtrate were placed in a counting vial and counted in a liquid scintillation counter.[4] Similarly prepared dilutions of the injection solution were also counted. Body water space was calculated using the Y-intercept of counting rate vs. time after TOH injection, assuming 91.5% water in plasma. Corrections were not made for possible hydrogen ion exchange. Water turnover was calculated using the body water space and the biological half-life of tritium activity in the plasma.

Results. Table I shows the decrease in PUN which occurred following DES implantation. This response is similar to that previously reported (1). It should be noted that maximum depression in PUN occurred on the day that body water space determinations were made.

The tritium activities of the plasma-TCA filtrates are shown in Fig. 1. Calculated body water space and turnover rates are shown in Table II. Body water space was virtually equal between the two treatments; this is also supported by the lack of change in PCV.

[1] Contribution from the Missouri Agricultural Experiment Station. Journal Series No. 5672; approved by the Director.

[2] Supplied by Chas. Pfizer and Co., Terre Haute, Ind.

[3] Purchased from New England Nuclear Corp., Boston, Mass. (1 mCi/g).

[4] Packard Instrument Co., model 3003.

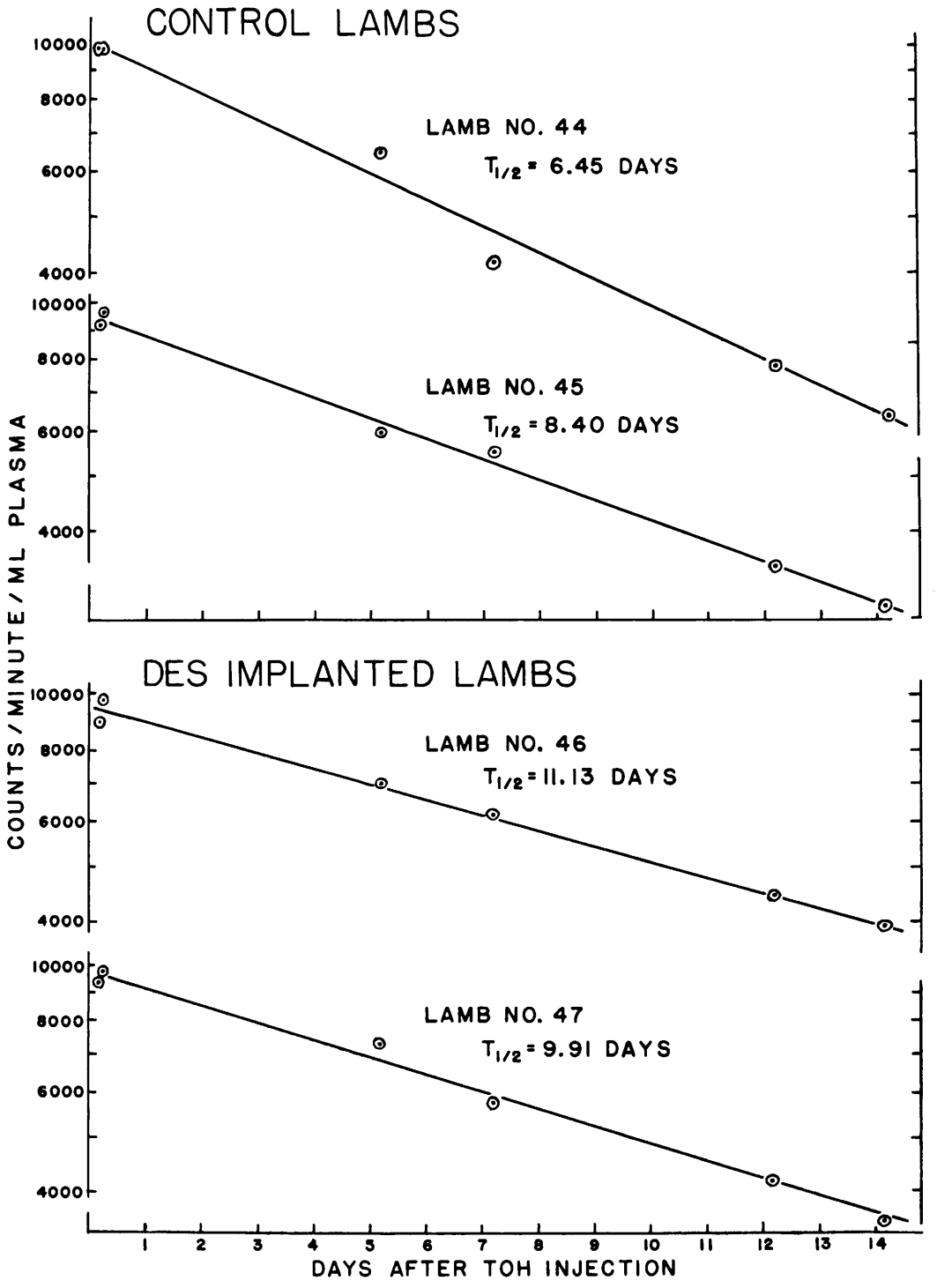

FIG. 1. The tritium activities of the plasma-TCA filtrates.

TABLE I. Influence of DES on Plasma Urea-N.

Days within period	Urea-N (mg/100 ml)[a,b]		p^c
	Group 1	Group 2	
Preliminary period (24 days)			
13	15.4	14.7	>.25
15	17.7	17.8	>.25
20	14.3	14.8	>.25
22	14.4	13.2	>.25
Experimental period (27 days)			
3	13.5	11.0	.10
5	14.8	10.2	.04
10	13.4	9.3	.05
12	14.8	9.1	.03
17	15.0	11.7	.07
19	14.0	10.1	.05
24	14.6	14.5	>.25
26	14.5	14.4	>.25

[a] $S_{\bar{x}} = 0.85$; $n = 2$.

[b] CV between duplicate samples = 1.0%.

[c] Probability of the difference being due to chance.

While not significant, it appears that water turnover rate was 29% less in the lambs implanted with DES. Weight gains during the experimental period were increased 45% in the lambs implanted with DES. This increase occurred with equal intake of feed.

TABLE II. Influence of DES on Body Water, Packed Cell Volume, Water Turnover, and Weight Gain in Lambs.

Criterion	Treatment		Probability[b]
	Control	DES[a]	
Body water space[c] (%)	60.3	59.8	>.25
Packed cell volume (%)	36.5	36.6	>.25
Water turnover[d] (ml/day)	1831	1303	.12
Daily body wt change[e] (g)	107	155	.11

[a] A 3-mg implant of diethylstilbestrol.

[b] Probability of the difference being due to chance.

[c] Percentage of body weight; determined 12 days after DES implantation.

[d] Based on biological half-life of tritium present in plasma-TCA filtrates and the body water space.

[e] During the 27-day experimental period.

Discussion. The results of this experiment eliminate the possibility of increased body water space as an explanation for the reduction in PUN following DES administration in lambs. To account for the PUN depression observed in this experiment, body water space would have to be 98% of the body weight. Differences in PCV showed no trend during the experimental period, similar to results reported previously (1). Decreases have been noted in humans (4, 5). Increased body weight gain, along with decreased PUN are in line with known changes following DES administration, indicating that the lambs in this experiment were responding to DES implantation.

The water turnover rates reported in this paper (1831 and 1303 ml/day, respectively, for control and DES implanted lambs) indicate that DES may have some influence on water metabolism in ruminants. Part of the decreased turnover rate is no doubt associated with the increased body weight gain following DES implantation. The turnover rates are somewhat less than predicted, based on an equation developed from several mammals (10), somewhat less than reported for sheep in one study (11), but within the range of another report (12).

Summary. Four wether lambs were used to determine body water space following DES implantation. Tritium-labeled water was used as the tracer. Body water space was 60.3 and 59.8% of the body weight for the control and DES-implanted lambs, respectively. It is concluded that body water space is not changed 12 days after DES implantation in lambs; therefore, this does not explain the decrease in PUN observed following DES administration in ruminants.

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