Pharmacology Biochemistry & Behavior, Vol. 17, pp. 171–173, 1982. Printed in the U.S.A.

Postmortem Plasma Luteinizing Hormone Levels and Antemortem Violence

JACK H. MENDELSON, PARK ELLIOTT DIETZ AND JAMES ELLINGBOE

Alcohol and Drug Abuse Research Center, Harvard Medical School-McLean Hospital
115 Mill Street, Belmont, MA 02178

Received 10 March 1982

MENDELSON, J. H., P. E. DIETZ AND J. ELLINGBOE. *Postmortem plasma luteinizing hormone levels and antemortem violence*. PHARMAC. BIOCHEM. BEHAV. 17(1) 171–173, 1982.—Luteinizing hormone (LH) levels were determined in postmortem blood samples obtained from twenty-eight men who sustained sudden traumatic deaths. Violent antemortem behavior (committing suicide by gunshot or hanging, or killed during a violent attack or physical struggle) was associated with significantly higher LH levels than nonviolent antemortem behavior (pedestrians struck by vehicles, crime victims, and those shot during verbal arguments). Within both the violent and nonviolent groups, LH levels were higher in men with detectable alcohol in blood than in men with no alcohol in blood but these differences were not statistically significant. In the nonviolent group, men without alcohol in blood had LH levels within the normal range for healthy adult males. The stability of LH was established in serial studies of normal human male blood specimens over a range of temperatures and time durations comparable to conditions in postmortem blood sampling procedures. These findings suggest that postmortem LH levels in males may be a biological indicator of violent behavior immediately preceding death.

Luteinizing hormone Antemortem violence Postmortem blood

THE possibility that aggressive behavior is systematically associated with some biological variable has been explored in many models and has led to conflicting conclusions [5]. It is well established that alcohol intoxication is associated with an enhancement of aggressivity and greater risk-taking behavior. Moreover, alcohol suppresses gonadal steroidogenesis [3,6] with a concomitant elevation of luteinizing hormone (LH) levels [6] as a consequence of gonadal steroid feedback control of gonadotropin secretory activity. These data suggested that LH activity might be associated with aggressivity in non-alcohol related situations. This report describes the relationship between LH levels and antemortem violent behavior in men who sustained sudden traumatic deaths.

Luteinizing hormone, a glycoprotein with a molecular weight of 22,000–25,000, is secreted episodically by the anterior pituitary in response to stimulation by hypothalamic gonadotropin releasing hormone. LH regulates, in part, gonadal steroid production in males and the surge of this hormone during mid-cycle induces ovulation in females. LH is relatively stable in blood. The hormone undergoes biotransformation in the proximal convoluted tubules of the kidney, and in humans renal degradation represents the primary process of inactivation of LH [2].

METHOD

In order to assess the stability of LH levels in human blood, pooled blood samples were obtained from four healthy adult males. Table 1 presents values for LH determined in serum samples which were frozen at −70°C and maintained at +4°C and +25°C for one to 48 hours. The temperatures and time durations were selected to approximate conditions following death. Storage of serum samples at +4°C and +25°C for one to 48 hours resulted in a 9 percent decrement in LH. The LH values observed under −70°C storage conditions (41.0±1.4 ng/ml) and the mean LH values for all samples stored at +4°C and +25°C for 1 to 48 hours (36.6±2.4 and 35.0±2.0 ng/ml respectively) were within the range of LH levels determined in blood samples obtained from 38 normal adult males (47.4±12.5 ng/ml).

Blood samples were obtained from 28 adult males (age 18 and over) who sustained sudden death from trauma under conditions in which their antemortem behavior was known. Antemortem behavior was ascertained through investigative reports of the circumstances of death. Blood specimens were obtained between 5 and 35 hours following death. All samples were centrifuged and the serum frozen for analysis of LH. Blood samples were coded prior to LH analysis so that LH determinations were carried out blindly with respect to postmortem blood alcohol level and circumstances of death. LH was determined by a double antibody method similar to that described by Midgley [7]. LH concentrations are expressed as ng LER-907 reference standard /ml serum. Materials for the radioimmunoassay of LH were provided by the National Pituitary Agency, NIMDD. We have utilized this assay in previous alcohol-related studies with adult males and have determined that addition of ethanol to plasma samples does not interfere with the LH radioimmunoassay [6].

TABLE 1

LUTEINIZING HORMONE LEVELS IN POOLED BLOOD SAMPLES FROM FOUR HEALTHY ADULT MALES STORED AT −70°C AND 1 TO 48 HOURS AT +4°C AND +25°C

Temperature (°C)	Time (hours)	LH (ng/ml) Mean	S.E.
−70°	—	41.0	1.4
+4°	1	37.0	0.6
+4°	5	36.3	1.4
+4°	24	37.9	5.1
+4°	48	35.3	2.3
+25°	1	36.4	1.0
+25°	5	33.1	2.7
+25°	24	33.1	2.5
+25°	48	37.4	1.8

RESULTS

Table 2 shows postmortem LH levels for each of 7 classes of antemortem behavior. LH levels were not significantly correlated with age or with time elapsed between death and blood sampling. LH levels were not significantly different between men committing suicide and men killed during a violent attack or physical struggle. These two categories were combined with a single "Russian roulette" case to form a group with documented antemortem violent behavior. LH levels were not significantly different among pedestrians struck by vehicles, crime victims, and men shot during verbal arguments, and these 3 categories were combined to form a group with documented victimization without antemortem violent behavior.

Men in the violent group had a very high mean LH level (194.7 ng/ml) which was significantly greater than that of the non-violent group (71.6 ng/ml) ($p<0.005$). Non-violent men with positive blood alcohol determinations had a significantly higher LH (76.6 ng/ml) than healthy volunteers (47.4 ng/ml) ($p<0.005$). However, men in the non-violent group without positive blood alcohol had LH levels comparable to mean LH levels of normal males.

Men in the violent group with positive blood alcohol determinations had significantly higher LH than either men in the non-violent group with positive blood alcohol determinations or healthy volunteers ($p<0.005$). LH was lower among alcohol negative suicides than other violent subgroups. Men in the violent group with negative blood alcohol did not have significantly higher LH levels than their non-violent counterparts but had significantly higher LH levels than healthy volunteers ($p<0.005$).

In violent suicide fatalities (gunshot or hanging) LH levels were significantly higher for men with positive blood alcohol determinations than for those with no alcohol in the blood ($p<0.005$). For other classes of violent antemortem behavior the observed differences in mean LH between alcohol-positive and negative cases were not statistically significant. The observed differences in LH levels between the alcohol-negative and alcohol-positive men were not statistically significant within the violent group, within the non-violent group or for the total sample.

DISCUSSION

There are numerous hormonal and neural regulatory mechanisms which may affect LH levels in blood. Under normal conditions stimulation of LH secretory activity by hypothalamic gonadotropin releasing hormone is modulated by feedback effects of gonadal steroids [1]. However, it is unlikely that alterations in normal steroid feedback were responsible for the very high LH levels observed in men with histories of antemortem violence because of the relatively short time course of violent behavior antecedent to death. It has been shown that LH secretory activity is regulated, in part, by catecholamines and endogenous opioid peptides [4]. Changes in the levels, turnover or action of these neurotransmitters in the hypothalamus, and other regions of the brain during states of violence may produce concomitant alter-

TABLE 2

POSTMORTEN SERUM LUTEINIZING HORMONE (LH) LEVELS AMONG ADULT MALES DYING SUDDENLY OF TRAUMA UNDER CONDITIONS OF VIOLENT AND NONVIOLENT ANTEMORTEM BEHAVIOR

	Blood Alcohol					
	Negative		Positive		Total	
Antemortem Behavior of Decedent	N	LH	N	LH	N	LH
Violent						
Killed during violent attack or physical struggle	2	255.9 ± 0.6	2	147.2 ± 53.4	5*	179.7 ± 77.8
Violent suicide	3	84.1 ± 28.7	5	206.1 ± 97.4	8	160.4 ± 98.2
"Russian roulette"	0		1	545.0	1	545.0
Violent group total	5	152.8 ± 96.3	8	233.8 ± 148.6	14*	194.7 ± 131.6
Nonviolent						
Pedestrian struck by vehicle	0		4	89.9 ± 18.8	5*	83.5 ± 21.7
Crime victim	2	51.0 ± 24.0	3	84.7 ± 16.5	5	71.2 ± 24.9
Shot during argument	1	76.1	3	50.8 ± 13.5	4	57.2 ± 16.8
Nonviolent group total	3	59.3 ± 22.3	10	76.6 ± 23.2	14*	71.6 ± 22.8

Values are mean LH (ng/ml) ± standard deviation.
*Includes one case with blood alcohol concentration unknown.

ations in the episodic release of LH from the pituitary. The significance of such regulatory processes for relationships between LH levels and violence may be more systematically explored in animal studies utilizing models of experimentally induced aggression. At present, determinations of LH levels in postmortem blood samples from adult, human males may serve as a useful biological marker of violent behavior immediately preceding death.

ACKNOWLEDGEMENTS

This study was supported, in part, by a grant from the Insurance Institute for Highway Safety, Washington, DC and grant DA 00064-02 from the National Institute on Drug Abuse, ADAMHA, Rockville, MD. This skilled technical assistance of Mr. Paul Heffernan, who carried out the LH determinations and LH stability study, is gratefully acknowledged.

REFERENCES

1. Bardin, C. W. The neuroendocrinology of male reproduction. In: *Neuroendocrinology,* edited by D. T. Krieger and J. C. Hughes. New York: HP Publishing Company, 1980, pp. 239–248.
2. Bennett, H. P. J. and C. McMartin. Peptide hormones and their analogues: Distribution, clearance from the circulation and inactivation in vivo. *Pharmac. Rev.* **30:** 247–292, 1978.
3. Ellingboe, J. and C. C. Varanelli. Ethanol inhibits testosterone biosynthesis by direct action on Leydig cells. *Res. Communs chem. Path. Pharmac.* **24:** 87–102, 1979.
4. Frohman, L. A. Neurotransmitters as regulators of endocrine function. In: *Neuroendocrinology,* edited by D. T. Krieger and J. C. Hughes. New York: HP Publishing Company, 1980, pp. 44–57.
5. Hamburg, D. A. and M. B. Trudeau (editors). *Biobehavioral Aspects of Aggression.* New York: Alan R. Liss, 1981.
6. Mendelson, J. H., N. K. Mello and J. Ellingboe. Effects of alcohol on pituitary gonadal hormones in normal males. *J. Pharmac. exp. Ther.* **202:** 676–682, 1977.
7. Midgley, A. R. Radioimmunoassay: A method for human chorionic gonadotropin and human luteinizing hormone. *Endocrinology* **79:** 10–18, 1966.