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J. I. Coe, M.D.[1]

Postmortem Values of Thyroxine and Thyroid Stimulating Hormone

While morphological changes may be correlated with physiological abnormalities, such associations are usually apparent only when the anatomic pathology is severe. Marked biochemical abnormalities may exist with little or no apparent tissue change. Conversely striking anatomic lesions may have no significant laboratory findings. It is for this reason that any pathologist is interested in postmortem chemical studies hoping he may be able to determine physiological abnormalities that existed while the patient was alive. This is particularly true of the forensic pathologist who usually has no antemortem hospital studies to assist him.

Extensive biochemical work has been performed on blood, cerebrospinal fluid, and more recently the vitreous humor for a wide variety of substances. However, only a few reports on postmortem hormonal studies are available. Lund [*7*] in 1963 studied adrenalin and noradrenalin in cases of sudden death. He found postmortem values to be even higher than antemortem values in people with known pheochromocytomas or accidental adrenaline poisoning. In contrast Finlayson [*4*], studying serum cortisol, has found postmortem levels remain constant for at least 18 hours after death and are the same as antemortem values.

The author has for several years carried on chemical studies of blood and vitreous humor demonstrating how such determinations can aid the forensic pathologists in arriving at the cause of death or in his interpretation of equivocal autopsy findings [*1–3*]. Recently several cases have come through the Hennepin County Medical Examiner's Office where evaluation of thyroid function would have been of help. One involved a slender, middleaged women who had not seen a physician for years. The little clinical data available along with autopsy findings of a hyperplastic thyroid gland, diffuse lymphadenopathy, and mild cardiomegaly without vascular disease, all suggested the possibility of hyperthyroidism. In two other cases severe chronic thyroiditis suggested the possibility of hypothyroidism. No data could be found in the literature on postmortem blood values for thyroxine (T_4) and thyroid stimulating hormone (TSH) now being used to evaluate thyroid function at the General Hospital. The present work was undertaken to establish a baseline of postmortem values for individuals with normal antemortem thyroid function.

Method

Individuals selected for evaluation were all patients at the Hennepin County General Hospital. They were admitted for and died with a variety of conditions including coronary

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[1] Chief of Pathology, Hennepin County General Hospital, Hennepin County Medical Examiner, Minneapolis, Minnesota 55415.

sclerosis, cerebrovascular accidents, renal failure, cirrhosis with hepatic failure, septicemia, leukemia, pneumonia, asphyxia, barbiturate poisoning, and electrocution. None manifested thyroid dysfunction clinically. All cases were autopsied and revealed no gross or microscopic evidence of thyroid disease.

Collection of material was slow. It was necessary after a patient expired to go to the hospital laboratory and try to retrieve serum that had been drawn for other tests. Frequently none was available or the supply was inadequate for analysis. In the cases reported below commonly only 1 to 1.5 cc of antemortem serum was available for determining what the T_4 was during life. This frequently prevented performing the tests in duplicate.

When it was determined that some antemortem serum was available, blood was drawn at intervals after death in the following manner. The first specimen would be obtained by subclavian puncture as soon as possible after the body had been brought to the morgue. A second specimen was occasionally obtained by subclavian puncture 16 to 24 hours later when it was recognized that there would be a delay in performing the autopsy. A final specimen would then be obtained during the autopsy by cardiac puncture as soon as the pericardial sac was opened.

One of the antemortem and several of the postmortem specimens revealed mild hemolysis. Two specimens (patients #16 and 21) obtained 40 and 60 hours after death revealed severe hemolysis.

Initially only T_4 was determined. This was performed by the Radioisotope Laboratory at the Hennepin County General Hospital using the Abbott Laboratory's "Tetrasorb–125". This is based on the competitive protein binding analysis developed by Murphy and Pattee [*9*] and modified by Kowal, Korn and Sirota [*6*]. Duplicate analyses are routinely performed on all specimens where sufficient serum is available, and the results are corrected for extraction efficiency. The normal range in the laboratory following this procedure is 5.0 to 13.7 micrograms/100 ml.

After an initial eight cases showed that T_4 could fall following death, it was decided to obtain thyroid stimulating hormone assays as well. These were performed in the Metropolitan Reference Laboratory, Minneapolis, Minnesota by radioimmunoassay using the procedure recommended by the National Pituitary Agency who supplied the TSH antisera and pure TSH for labelling. Clinical interpretation is given by Mayberry et al [*8*] and by Hershman and Putman [*5*]. The normal range as established by the Reference Laboratory during the period of this investigation was 0–14 microunits/ml.

Results

The results of the analyses for thyroxin on twenty-one thyroid normal individuals are given in Table 1 along with basic data concerning age, sex, and cause of death.

The results of thyorid stimulating hormone are given in Table 2. The patient numbers used in Table 2 correspond to those used for the same individual in Table 1.

Besides the values shown in Table 1, there were T_4 determinations performed on one other individual. This was a 61 year old white female who was treated for arteriosclerotic heart disease, but succumbed to ventricular fibrillation. She had no symptoms of thyroid disease clinically; but at autopsy she was found to have a moderately enlarged, greyish-white gland that microscopically revealed a lymphocytic thyroiditis, as shown in Fig. 1. An antemortem T_4 value on this patient was 8.1 micrograms percent, while specimens obtained seven and twenty-nine hours postmortem revealed values of 6.5 and 4.8 micrograms percent respectively.

TABLE 1—*Comparative antemortem and postmortem values of thyroxine in euthyroid individuals.*

Patient				Tetraiodothyronine, microgram/100 cc							
					Postmortem Interval and Values						
Case Number	Age	Sex	Cause of Death	Ante-Mortem T_4	Hours (1–6)	T_4	Hours (6–24)	T_4	Hours (>24)	T_4
1	49	M	Cirrhosis with hepatic failure	10.0	4	7.5	21	5.9		
2	26	F	Barbiturate poisoning	7.8	1¾	5.8	20	5.3		
3	64	M	A.S.H.D	7.9	1	6.5	15	7.3		
4	72	M	Bronchopneumonia	5.7	1	5.4	15	4.9		
5	82	F	C.V.A.	8.9	2	9.0	14	6.9		
6	72	M	Septicemia and A.S.H.D.	5.8	½	5.3	14	4.4		
7	66	M	Renal failure, A.S.H.D.	6.8	1	6.5	10	5.0		
8	55	M	Perforated ulcer	6.0	1¼	5.4	22	5.4		
9	65	M	Lobar pneumonia and renal failure	6.3	2¼	5.9	21	5.3		
10	75	F	A.S.H.D.	9.3			19	6.6		
11	69	M	A.S.H.D.	9.5			18	5.2		
12	65	M	Rupture of esophagus	5.8			12	4.4		
13	47	M	A.S.H.D.	8.4			19	5.4		
14	32	M	Electrocution	9.0			19	7.6		
15	59	F	C.V.A.	8.5			15	10.3		
16	50	M	Asphyxia–epilepsy	8.9	1	7.4	16	8.0	40	8.3
17	98	M	Perforated ulcer	8.5	2½	4.9			28	5.0
18	85	M	A.S.H.D. and peritonitis	10.6	2	10.1			50	8.5
19	60	M	Cirrhosis with encephalopathy	6.4	1½	6.0			28	4.6
20	22	F	Leukemia and pneumonia	8.2			24	3.7	46	5.0
21	51	F	C.V.A.	9.8					60	8.3

A.S.H.D. = Arteriosclerotic heart disease
C.V.A. = Cerebrovascular accident

TABLE 2—*Comparative antemortem and postmortem value of thyroid stimulating hormone in euthyroid individuals.*

		Thyroid Stimulating Hormone microunits/ml,					
			Postmortem Intervals and Values				
Patient Number	Ante-mortem TSH	Hours (1–6)	TSH	Hours (6–24)	TSH	Hours (>24)	TSH
2	6	1¾	6	20	0		
3	8	1	8	15	7		
4	16	1	15	15	13		
6	7	½	9	14	11		
7	6	1	1	10	4		
8	0	1¼	6	22	7		
9	2	2¼	2	21	2		
14	6			19	4		
15	4			15	5		
16	7			15	7		
17	6	1¾	6			28	0
18	4	2	4			50	4
20	4	2	2			46	>2

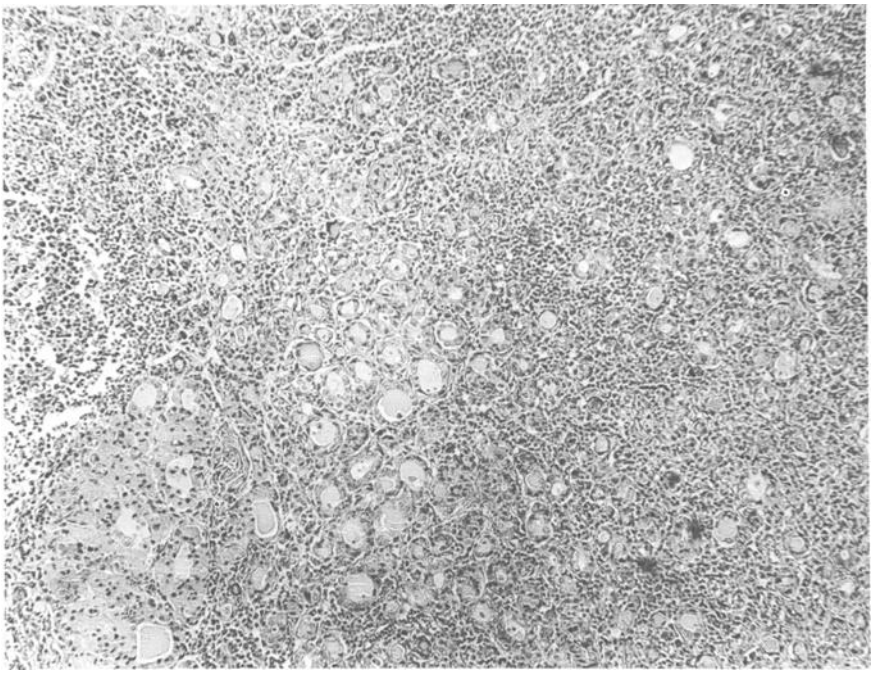

FIG. 1—*Chronic lymphocytic thyroiditis (X100).*

Discussion

The data in Table 1 shows a decline in the level of T_4 between antemortem and postmortem levels in all but one patient (#15) although several cases show a rise between two successive postmortem values. The average rate of decline is shown in Table 3. However, rates of decline for individual cases were irregular and erratic. In one case (#17) there was a decline of 3.6 micrograms percent in less than three hours after death, while in three cases (#1, 11 and 20) there was a decline of over 4 micrograms percent in less than twenty-four hours. As a consequence, there are several cases with postmortem values suggestive of hypothyroidism when no glandular abnormality existed.

TABLE 3—*Average rates of postmortem change in thyroxine and thyroid stimulating hormone. (Based on data given in Tables 1 and 2).*

Tetraiodothyronine		Thyroid Stimulating Hormone	
Average Postmortem Interval h	Average Deviation from Antemortem T_4 micrograms/100 cc	Average Postmortem Interval h	Average Deviation from Antemortem TSH, microunits/ml
1.7	−1.1	1.5	0
17	−1.8	17	−0.2
42	−2.1	41	−3

The danger of utilizing such values becomes doubly apparent when considering the single case of chronic thyroiditis presented. Here the histological picture shows sufficient pathology to suggest possible glandular dysfunction and a T_4 value of the serum twenty-nine hours after death is consistent with mild hypoactivity. However, antemortem and early postmortem T_4 values show no functional abnormalities to have existed.

The data on thyroid stimulating hormone values reveals that they are more stable than thyroxine. In the first twenty-four hours after death, the values for TSH went up as often as down. Thus, averaging the positive and negative deviations from antemortem values, they cancelled each other out leaving an average deviation of essentially zero as shown in Table 3. While individual cases showed variation, it was always within the range of normal values. Few long postmortem intervals were available making it unsafe to evaluate later deterioration of the TSH, but two of the three cases obtained do show preservation of the hormone for at least two days after death.

With the data now available, what can one predict about postmortem values in patients with thyroid dysfunction? It would seem that elevated values of either T_4 or TSH would be significant. Thus, it should theoretically be possible to detect both hypo and hyperthyroidism. However, it remains to be proven that the elevated T_4 values in individuals with hyperthyroid function will not fall into the normal range after death and that TSH values in abnormal patients are as stable as in euthyroid individuals.

Conclusions

Comparative antemortem and postmortem thyroid function studies were performed on euthyroid individuals dying from a variety of causes. It was found that T_4 values tend to fall after death. The rate of fall was individual and erratic causing postmortem values in some cases to be in the range of hypothyroid individuals. In contrast TSH values showed minor variations and remained in the normal range for at least one day after death.

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