from peak II was completely negative even when the protein concentration was 50 times that of the protein from peak I. The presence of univalent antithyroglobulin antibody in the material contained in peak II was established by the capacity of this protein to inhibit specifically the hemagglutination of thyroglobulin coated cells by bivalent 7 S antibody. Based on such studies it is estimated that at the concentration of protein in peak II, no more than 0.5 percent bivalent antibody could be present but not detectable by hemagglutination due to the inhibitory effect of the univalent fragment (*6*).

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Tissue Levels of Norepinephrine and Epinephrine in Hemorrhagic Shock

Abstract. *Severe depletion of endogenous norepinephrine was observed in the brain, heart, liver, and spleen of albino rabbits in which hemorrhagic shock had been induced. On the other hand, the epinephrine content of these tissues was significantly elevated above the levels in tissues of control animals. The norepinephrine and epinephrine levels of skeletal muscle in shocked animals remained unaffected.*

As discussed in an earlier report, the heart in hemorrhagic shock was observed to be markedly depleted of its endogenous norepinephrine (*1*). Although the epinephrine concentration in the myocardium was significantly elevated, the total catecholamine content (norepinephrine plus epinephrine) was reduced to 34 percent of the content for control animals. A study was undertaken (*2*) to determine whether similar alterations of norepinephrine and epinephrine levels occurred in other tissues of animals in hemorrhagic shock.

Table 1. A comparison of norepinephrine (NE) and epinephrine (E) levels in tissue of normal rabbits and of rabbits in which hemorrhagic shock had been induced.

Organ	Levels (μg/g)*				*P* values†	
	Controls		Shocked animals			
	NE	E	NE	E	NE	E
Heart	1.05 ± 0.13 (12)	0.14 ± 0.06 (12)	0.16 ± 0.05 (12)	0.24 ± 0.06 (12)	< .001	< .01
Spleen	0.49 ± 0.10 (10)	.08 ± 0.03 (12)	.00 (4)	.36 ± 0.05 (4)	< .001	< .01
Brain	.32 ± 0.04 (20)	.02 ± 0.009 (20)	.10 ± 0.04 (13)	.12 ± 0.05 (13)	< .01	< .025
Liver	.19 ± 0.05 (12)	.07 ± 0.026 (14)	.06 ± 0.03 (12)	.23 ± 0.07 (12)	< .05	< .025
Muscle	.19 ± 0.05 (12)	.02 ± 0.027 (13)	.10 ± 0.03 (13)	.06 ± 0.04 (13)	> .27	> .30

* Mean; standard error; number of animals (in parentheses). † Calculated by Student's *t*-test.

In albino rabbits ranging in weight from 1 to 3 kg the left femoral artery was cannulated after infiltration of the area with 2-percent procaine. Before the animal was subjected to shock, an initial dose of heparin (5 mg/kg) was administered by vein as an anticoagulant; thereafter, heparin (half of the initial dose) was administered every hour throughout the experiment. Hemorrhagic shock was induced by bleeding from the cannulated artery into a reservoir which was placed at a height equivalent to pressure of 50 mm-Hg (*1*). This level of pressure was maintained for 3 hours, after which the animal was sacrificed by rapid withdrawal of blood from the cannulated artery with a syringe. Samples (approximately 1 g) of brain (diencephalon), heart (left ventricle), liver (left lobe), skeletal muscle (gluteal), and spleen were quickly removed, weighed, and homogenized in a Potter-Elvehjem tissue grinder containing 6 cm^3 of cold 10-percent trichloroacetic acid. The supernatant liquid, after centrifugation under refrigeration, was extracted three times with diethyl ether. The aqueous fraction was diluted with an equal volume of 0.2*N* sodium acetate, and the *p*H was adjusted to 8.2 with 0.5*N* sodium carbonate. The tissue extract was then passed through an alumina column (Fischer) which had previously been washed three times with triple-distilled water. Eluates from the chromatographic columns, together with norepinephrine and epinephrine standards, were analyzed in accordance with a modification of the trihydroxyindole method (*3*). The resulting fluorescence was measured with a Farrand photofluorometer, arbitrarily adjusted to a sensitivity sufficient for detecting 0.01 to 1.5 μg of norepinephrine and epinephrine per gram of tissue. The catecholamine levels determined in the tissue of the shocked animals were compared to levels found in tissue of control rabbits subjected to a cannulation of the femoral artery without bleeding. These animals were killed instantly by a high cervical spinal transection.

In Table 1, the concentrations of norepinephrine and epinephrine in tissue of animals in which hemorrhagic shock had been induced are compared with the concentrations in tissue of control animals. In organs, such as heart and spleen, for which levels of endogenous norepinephrine were found to be relatively high in the controls, levels of the hormone were found to be profoundy reduced in the shocked animals. Levels were reduced in heart and spleen by 85 and 100 percent, respectively. The level of norepinephrine was reduced to a lesser extent in brain (69 percent) and in liver (68 percent), and the concentration in skeletal muscle was not statistically different from that in the controls ($P > .27$). In contrast to the decrease in levels of norepinephrine there was an increase in levels of epinephrine in brain, heart, liver, and spleen in the shocked animals (Table 1). Probably the rise in the concentrations of epinephrine in tissue stems from the high adrenal output of this hormone in hemorrhagic shock (*4*). However, our experimental data do not give any indication of the mechanism of norepinephrine depletion. Experiments for comparing the rate of synthesis with the rate of utilization of norepinephrine would explain the lowering of levels of this catecholamine in tissue of the shocked animal.

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