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Haemorrhagic, traumatic and tourniquet shock in the rat

SIR,—Gecse, Karady & West reported in 1964 that one colony of Wistar rats (termed non-reactors) was genetically more resistant to tourniquet and traumatic shock than were other colonies (termed reactors). We have now considered whether these differences can be accounted for by differences in the reactivity of their plasma kinin systems, especially as bradykinin is known to be involved in some forms of shock (Rocha e Silva & Antonio, 1960; Brocklehurst & Lahiri, 1962).

Groups of 10 non-reactor Wistar rats, weighing 150–200 g, obtained from the Agricultural Research Council's Field Station at Compton, and groups of 10 reactor Wistar rats from Fison's Ltd., Holmes Chapel, were subjected to haemorrhagic shock by the withdrawal of 15 ml blood/kg, traumatic shock (Noble & Collip, 1942), or tourniquet shock (Wilson & Roome, 1936). At different times after these procedures, the circulating levels of free kinin, kininogen, kininase and kinin-forming enzymes were measured (Dawson, Starr & West, 1966). Plasma kininogen level was the only parameter to show consistent changes and these occurred within 10 min of each type of shock; for example, the levels of the kinin precursor in reactor rats increased about three-fold but these were not sustained and returned to control values by 30–60 min. These changes in kininogen are similar to those reported by Diniz & Carvalho (1963) during haemorrhagic shock in the dog. Non-reactor rats showed similar changes in haemorrhagic and traumatic shock (25 min at 40 rev/min) but not in tourniquet shock (4 hr duration) where the kininogen levels were not raised during the experimental period. The plasma kinin systems in liver, heart, lung and small intestine were also unchanged after each type of shock in both types of rat.

Rats dying after severe shock always showed intestinal haemorrhage and experiments were therefore made to study kinin release into the peritoneal cavity, where it may arise from activation of its precursor by the action of kinin-releasing enzymes originating from pro-enzymes in the stagnating blood or from stores in the walls of the intestine. Immediately after subjecting other groups of rats to the different shock procedures, therefore, the peritoneal cavity of each rat was washed with 5 ml of 0·9% (w/v) saline and the washings were assayed for kinin-like activity. Whereas at all times after haemorrhagic shock, the bradykinin levels in the peritoneal fluid did not increase above the basal values (about 10 ng), the levels after the other two types of shock increased, the extent depending upon the intensity of the shock applied (Table 1).

TABLE 1. EFFECT OF TOURNIQUET SHOCK AND TRAUMATIC SHOCK ON THE AMOUNT OF BRADYKININ (ng) DETECTED IN THE PERITONEAL FLUID AND ON THE MORTALITY RATE (%) OF RATS OVER 24 HR

Type of shock	Conditions of shock	Bradykinin		Mortality rate	
		R	NR	R	NR
Tourniquet	2 hr	12	10	45	0
	3 hr	17*	10	100	45
	4 hr	40*	24	100	85
	6 hr	73*	32*	100	100
Traumatic	10 min	75	28	0	0
	15 min	101	65	0	0
	25 min	31*	35*	25	10
	40 min	40*	41*	100	75

R = Reactor animals. NR = Non-reactor animals.
* These samples also contained significant amounts of histamine.

Kinin levels in reactor animals were nearly always higher after tourniquet and traumatic shock than those in non-reactor rats, and when the mortality rates were recorded over 24 hr non-reactor rats were found to be more resistant. Histamine also occurred in the peritoneal fluid in relatively large amounts (over 50 ng per rat) when the stimulus was large enough to be lethal in 24 hr, but only small amounts of 5-hydroxytryptamine (about 10 ng) were present in all samples.

No differences were found between the plasma kinin systems *in vitro* of reactor and non-reactor rats and it may be that kinins are only of secondary importance in the shock states studied. But the high kininase activity of the blood, liver, lung and intestine may account for the rapid disappearance of the free peptide. The ease with which kinin release is achieved, especially in rat plasma (Jacobsen & Waaler, 1966), indicates that when conditions are favourable (as in congested intestine), secondary kinin formation may occur and this then aggravates the existing state of shock.

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