liver degeneration, was studied *in vitro*. The characteristic respiratory decline, *i.e.*, breakdown of O_2 consumption in the Warburg apparatus, was prevented by addition of most compounds at catalytic dose levels. With increasing amounts of compounds, dose response curves were obtained. The scale of relative potencies *in vitro* followed closely that previously established *in vivo* for protection against liver necrosis by feeding of the compounds, as well as for reversal of respiratory decline by intraportal injection, with the exception of Vit. E and methylene blue. Tocopherol and its esters were completely inactive *in vitro*, while the tocopherol metabolite showed high potency in preventing the metabolic lesion. Methylene blue, inactive in the *in vivo* systems, was highly potent in the Warburg assay. The most potent substance, DPPD, produced a significant effect with .06 μg/100 mg of liver tissue in 3 cc medium. Santoquin, Santoflex B and amylhydroquinone were effective at doses from less than 1 to 6 μg. Less protection was found with phenolic compounds, such as NDGA, Propylgallate, DBPC and BHA; hydroquinone and Propylparasept were without activity. It is concluded that the substances act directly in the liver cell, perhaps not merely as antioxidants but as catalysts in intermediary metabolism.

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Comparison of Normal and Buffered Saline Solution for Fluid Replacement Following Tourniquet Shock.* (25320)

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Most experimental work dealing with electrolyte solution replacement after tourniquet trauma has been done with isotonic NaCl solution. The parenteral or oral use of adequate amounts of such solution protects against an otherwise lethal tourniquet trauma(1,2). Speculation on whether the therapeutic effect of saline derives from Na or Cl ion or both, is not new. Allen(3) reported that in treatment of tourniquet shock, normal saline gave better survival results than solutions more alkaline or more acid. He suggested that to combat acidosis, which accompanies shock, by alkaline solutions might actually be deleterious. Our method(1) of intravenous infusion in therapy of tourniquet trauma lends itself to a study of this problem. Our experiments were undertaken to compare survival rates, after an otherwise lethal tourniquet trauma, when animals were treated with isotonic NaCl or an alkaline buffered saline solution as used by Moyer(4). Induced pH and electrolyte changes were also measured.

Methods. Male albino rats of Holtzman Farms, weighing 200-250 g were used. Each animal was individually housed in air-condi-

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tioned laboratory for at least 4 days before use. Food was removed from cages approximately 15 hours before application of tourniquets(3). On morning of experiment, all animals were weighed, anesthetized and bilateral hind limb tourniquets applied for 4½ hours. This duration of trauma has been previously shown to be lethal to at least 96% of untreated controls in 200-250 g weight range. At time of tourniquet release, animals were again anesthetized and a polyethylene catheter introduced into the right jugular vein for administration of 1 of 2 therapeutic solutions.

Sol. 1	
Isotonic NaCl (pH 6.14)	154 meq Na^+/l 154 meq Cl^-/l
Sol. 2	
Saline bicarb. mixture (pH 8.12)	129 meq Cl^-/l 25 meq HCO_3^-/l
154 meq Na^+/l	154 meq/l

Infusion was begun 1 hour after release of tourniquets and rate of infusion so timed that 5 ml of solution was administered/100 g of body weight for 3 hours ±17 minutes. Infusions were given simultaneously by 2 or 3 variable speed constant infusion pumps, each having places for 12 syringes. At completion of infusion, the vein was ligated and the neck closed with skin clips. Then the animals were returned to their cages where food and water were available to them. Survival was recorded at 24 and 48 hours after tourniquet release. pH measurements were made (Beckman blood electrode pH meter) in 2 animals in each group at conclusion of infusion. In a separate experiment the serum electrolyte pattern was determined in both groups at conclusion of therapy. This was also done in appropriate untreated controls. Measurements of serum Na, K, CO_2 combining power and Cl were made. Blood for these measurements was withdrawn *via* a polyethylene catheter placed in carotid artery. CO_2 combining power was determined on Kopp Natelson Microgasometer. Chlorides were determined by method of Schales and Schales(5). Na and K levels were measured in internal standard flame photometer. These determinations were made in each of the following groups: Group I animals bled 1 hour after tourniquet release. Group II animals bled 4 hours after tourniquet release (control). Group III animals bled 4 hours after tourniquet release, having received 5 ml of isotonic saline solution/100 g body weight beginning at 1 hour and ending at 4 hours after tourniquet release. Group IV animals were bled 4 hours after tourniquet release, having received 5 ml saline-bicarbonate solution/100 g body weight beginning at 1 hour and ending at 4 hours after tourniquet release.

Results. Comparison of therapeutic effectiveness showed a slightly higher percentage of survival in Group III (isotonic sodium chloride group) (Table I). Chi square analysis of these data shows the difference not to be statistically significant ($p>0.10$).

Electrolyte determinations showed little difference between untreated control animals at one and 4 hours after tourniquet release. In groups treated with isotonic sodium chloride and saline-bicarbonate solutions, the serum electrolyte concentration was very much the same as in untreated groups, with the exception of a distinct elevation of serum chloride of the same degree in both groups, and a suggestive elevation of serum sodium in the bicarbonate-saline group.

Discussion. It has been previously demonstrated(1,2) that use of oral or parenteral electrolyte solutions in adequate amounts protects against the otherwise lethal effect of certain standardized plasma loss traumas (tourniquets, burns).

Rosenthal(6) was able to demonstrate no difference in therapeutic effectiveness between various Na solutions used in treatment of burns in mice. Moyer(4), however, using solutions tested in experiments in pre-burn treatments in dogs, demonstrated significantly longer survival time in a group treated with saline-bicarbonate mixture than in a group treated with isotonic sodium chloride solution.

The present study demonstrates that NaCl and saline-bicarbonate solutions have the same degree of protection as measured by survival rates (Table I). Further, the solutions produced an equivalent increase in serum chloride compared to controls. There was no demonstrable effect on CO_2 combining power.

Summary. 1. Simultaneous comparison

TABLE I. Survival following Intravenous Infusion of 5 ml/100 g Body Weight following 4½ Hr Bilateral Hind Limb Tourniquet Application.

	Type infusion	24 hr Lived	24 hr Died	24 hr % survival	48 hr Lived	48 hr Died	48 hr % survival	pH at conclusion of infusion
Exp. 1	.9% NaCl	8	2		7	3		7.40, 7.43
	Saline bicarbonate	8	2		5	5		7.53, 7.43
	Untreated control	2	2		0	4		
2	.9% NaCl	9	8		5	12		
	Saline bicarbonate	8	10		4	14		
	Untreated control	0	4		0	4		
Pooled results	.9% NaCl	17	10	63.0	12	15	44.4	
	Saline bicarbonate	16	12	57.3	9	19	32.1	
	Untreated control	2	6	25	0	8	0	

was made of therapeutic effectiveness of isotonic NaCl and saline-bicarbonate solutions when used in treatment of an otherwise lethal tourniquet trauma. The method of treatment allowed slow constant intravenous infusion of therapeutic solutions over period of greatest loss of fluid from circulating volume into traumatized extremities. The solutions were equally effective in increasing survival rate over that of untreated, traumatized controls. 2. Both solutions produced the same alteration in serum electrolyte concentration, *i.e.*, elevation of serum Cl values. The lowered CO_2 combining power of untreated control was not appreciably altered in the treatment groups.

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Effect of Relaxin on Mammary Gland Growth in the Female Rat.* (25321)

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All previous studies concerning the role of relaxin in growth of mammary gland in the rat have suggested that relaxin acts as a potentiator (or synergist) of lobule-alveolar growth in conjunction with estrogen and progesterone(1,2,3,4). Recently, in studies using desoxyribosenucleic acid (DNA) as a measure of mammary gland growth in both intact and gonadectomized male and female mice, it was shown that estrogen and relaxin alone are capable of stimulating increases in DNA associated with morphological evidence of marked lobule-alveolar growth(5,6). These and previous studies suggested that estrogen and progesterone stimulate endogenous secretion of relaxin and that relaxin might be the agent which stimulates increased secretion of pituitary mammogen rather than progesterone, since it was shown that estrogen and relaxin were ineffective in hypophysectomized mice. The present study extends our studies on the role of estrogen and relaxin in stimulating lo-

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