Title : Antacid Pulmonary Aspiration

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Introduction. Antacid administration orally during labor has been recommended as a means to reduce acidity of stomach contents should pulmonary aspiration occur. In dogs, we have shown that one emulsion-type antacid (Kolantyl Gel) can produce significant physiologic and pathologic derangement when aspirated. These studies indicated that the particulate nature of the antacid might be a contributing factor. This study examines the histologic and physiologic effects of two forms of a clear antacid, Na citrate, when aspirated by dogs in the same circumstances as our previous study.

Methods. Two groups of six dogs each were studied. After baseline studies were completed, one group aspirated 2 cc/kg of 0.3M Na citrate and 20% sucrose and the other aspirated 2 cc/kg of 0.3M Na citrate and saline flavored with 0.1 cc of spearmint oil. (The 2 cc total volume consisted of 0.5 cc of the respective Na citrate mixture diluted with an additional 1.5 cc of saline.) Systemic and pulmonary arterial pressures were monitored continuously. Arterial and central venous blood were sampled for blood gas tensions and pH before aspiration and at 10, 30, 60, 90, 120, 180 and 240 minutes after aspiration. Arterial samples were again taken at 24 and 48 hours after aspiration. The dogs were then sacrificed and their lungs removed en bloc for histologic evaluation. Two additional groups of four dogs each were given the same two aspirates in the same way. These dogs were sacrificed after one month. These results were compared with those from the previous study in which the aspirates consisted of saline, alkaline saline, antacid and acid.

Results. Mean PaO_2, $\dot{Q}s/\dot{Q}t$ and standard deviations are shown in Table 1. $\dot{Q}s/\dot{Q}t$ increased and PaO_2 decreased significantly in all groups ($P < 0.05$). The degree of change for these two variables was the same for Na citrate both in saline and in sucrose. Both in saline and in sucrose the citrate produced the same degree of change in both PaO_2 and $\dot{Q}s/\dot{Q}t$ as did the emulsion antacid at all times except that the decrease in PaO_2 was less with citrate in saline from 120 minutes on and the increase in shunt was less at 120 minutes ($P < 0.5$). Histologically, the aspirates produced four different patterns. (1) Saline and alkaline saline produced no visible pulmonary lesions in dogs sacrificed at 48 hours. (2) The acid aspirate produced extensive intravascular hemorrhage, exudate, edema, fibrin and polymorphonuclear leukocytes. (3) The antacid aspirate produced an extensive bronchopneumonia consisting of polymorphonuclear leukocytes and macrophages in about equal proportions. In addition, there were multiple areas containing granular particles around which the macrophages were clumped. (4) Na citrate 20% sugar and Na citrate with saline produced widely scattered foci of mild to moderate pneumonia among large areas of normal appearing lungs. The pneumonia consisted of polymorphonuclear leukocytes, a few macrophages and some red blood cells. Quantitatively, the histology was much less severe than that observed with either the acid or antacid aspirates. At one month, lungs having received either the citrate in sucrose or the citrate in saline were normal.

Discussion. When compared physiologically, there is little difference between derangements caused by citrate in sugar, citrate in saline and the emulsion antacid. However, when compared with the severe alterations produced by acid and the benign alterations produced by alkaline saline, the citrate in sugar more closely resembled acid and the citrate in saline resembled the alkaline saline. Histologically, there was no difference between the effects of citrate in saline and citrate in sugar. However, both of these agents produced a much less severe reaction than did either the emulsion antacid or acid aspirate. Furthermore, unlike the effects of the emulsion antacids, effects of the citrate antacids were gone by one month. If the clear antacids, particularly citrate in saline, can be proven to be as effective as the emulsion antacids in increasing gastric pH, they may be a better choice for prophylaxis.

Table 1 - Mean PaO_2 and $\dot{Q}s/\dot{Q}t$

	TIME (Minutes / Hours)									
	0	10	30	60	90	120	180	240	24H	48H
Saline (5.9)	81.2	59.6	61.0	64.9	70.8	72.8	74.8	73.1	91.3	88.6
(± S.D.)	6.0	8.8	10.5	12.7	13.3	11.5	13.4	12.3	5.9	8.4
Acid (1.8)	77.1	34.0	40.8	45.9	46.6	49.7	54.0	55.9	79.5	80.8
(± S.D.)	7.0	8.6	8.3	10.6	12.5	13.9	7.8	7.3	6.8	13.7
Antacid (8.3)	83.5	45.8	48.9	51.9	52.6	54.7	51.4	50.8	82.8	77.4
(± S.D.)	9.7	12.5	13.5	9.3	10.5	14.8	10.5	10.8	11.7	12.6
Alkaline Sal	82.8	57.8	62.5	67.0	68.5	69.1	69.7	74.3	91.5	92.6
(± S.D.)(8.3)	9.2	9.3	10.8	13.9	13.7	13.9	14.8	14.1	7.3	7.6
Sug Cit (8.3)	86.9	42.9	44.6	50.7	49.7	50.9	58.4	60.5	88.9	91.5
(± S.D.)	10.9	12.4	11.6	12.9	14.3	13.2	15.7	15.1	7.3	8.0
Sal Cit (8.3)	79.1	48.5	49.2	58.4	59.2	62.6	67.5	66.5	91.8	86.8
(± S.D.)	7.1	9.1	8.2	5.9	7.6	7.6	16.3	16.4	11.2	9.4
Saline (5.9)	15.1	33.6	31.1	30.9	22.6	19.2	19.2	17.6		
(± S.D.)	7.9	10.9	12.5	14.9	12.2	10.8	13.6	9.6		
Acid (1.8)	14.0	66.2	53.7	46.2	44.4	45.9	34.5	30.2		
(± S.D.)	10.8	15.8	16.7	17.4	19.0	19.0	14.5	11.9		
Antacid (8.3)	13.1	47.4	47.2	42.6	39.9	38.4	37.7	36.1		
(± S.D.)	8.1	18.2	13.9	10.7	11.3	17.8	10.4	10.4		
Alkaline Sal	16.2	42.0	31.9	26.4	22.8	19.9	22.0	17.1		
(± S.D.) (8.3)	5.8	13.3	13.9	15.4	12.8	13.2	13.6	11.4		
Sug Cit (8.3)	16.4	55.2	53.1	46.2	45.9	43.1	32.5	28.7		
(± S.D.)	22.0	13.8	15.6	14.2	13.9	12.2	13.8	14.1		
Sal Cit (8.3)	15.2	55.1	45.8	36.0	31.9	24.6	26.1	23.8		
(± S.D.)	9.8	17.4	14.9	12.3	12.4	12.6	16.3	17.0		

PaO_2 / $\dot{Q}s/\dot{Q}t$