Title: NO IMPROVEMENT IN PULMONARY STATUS BY GRAVITY DRAINAGE OR ABDOMINAL THRUSTS AFTER SEA WATER NEAR DROWNING IN DOGS

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Introduction. In experimental near drowning with fresh water or sea water inhalation, standard resuscitative measures can reoxygenate even without active drainage of water (1,2). Current guidelines for field management call for mouth-to-mouth resuscitation without delay by attempts at drainage. Past guidelines called for gravity drainage first. Recently, Heimlich proposed that water be expelled from the lungs by his abdominal thrust maneuver before starting IPPV (3). The purpose of this study was to determine whether gravity drainage or abdominal thrusts would alter the clinical course and recovery of pulmonary function after experimental near drowning with sea water.

Methods. We studied 3 groups of 5 dogs each. Under pentobarbital anesthesia and IPPV, catheters were placed in the abdominal aorta and pulmonary artery via the femoral vessels for monitoring of pressures, blood gases, cardiac output by thermodilution, hematocrit and serum electrolytes. EKG, airway pressure, DA-aO2, and $\dot{Q}S/\dot{Q}T$ were also monitored. After recovery of spontaneous breathing of air the tracheal tube was clamped at end-expiration until asphyxia led to apnea. After 15 sec of apnea, artificial sea water was instilled into the lungs, 30 ml/kg, from a height of 30cm. After 2 min of "drowning" drainage was begun. Group 1 (control) was drained passively with the tracheal tube held horizontal. Group 2 (gravity drainage) was placed 30° head down for 10 min. Group 3 (abdominal thrusts) was placed horizontal and treated with 4 abdominal thrusts (3) during 60 sec. In all groups, 60 sec after the end of flooding, IPPV/air was administered for 10 min to simulate on-site basic life support. Then IPPV/100% O_2 and IV albumin 5% (20 ml/kg+5 ml/kg per h) were administered for 30 min to simulate advanced life support during transport. Then IPPV/100% O_2 plus PEEP was administered for 3h, simulating hospital care. Weaning was attempted to 6h post drowning, when the dogs were sacrificed, the lungs examined grossly, and lung wet weight/dry weight determined. Differences between groups of data were statistically analyzed (significance=$p < 0.05$).

Results. The amount of water drained at 1 min was significantly greater in Groups 2 and 3 than in Group 1 ($p < 0.02$); however, by 10 min there was no significant difference (Table). In all 3 groups fluid drained was 25-28% more than the amount instilled. Although PaO_2 decreased transiently to 6-12 torr, cardiac arrest did not occur. Subsequently, transient hypoxemia, moderate hypocarbia, and moderate acidemia showed no significant difference between groups. After IPPV/air for 10 min, PaO_2 was 35±14 torr (Group 1); 43±8 (Group 2); and 36±7 (Group 3). After IPPV/100% O_2 for 30 min PaO_2 ranged widely without significant differences between groups. After IPPV/100% O_2 plus PEEP for 3h, PaO_2 was 279±137 torr (Group 1); 161±91 (Group 2); and 254±96 (Group 3) (no significant difference). There was also no significant difference between groups in DA-aO_2 and $\dot{Q}S/\dot{Q}T$ values; nor in lung water (Table). Inspite of albumin IV, $\dot{Q}T$ declined in all 3 groups to 60% control at 1-3h, and recovered to 70-90% at 6h with no significant difference between groups.

Discussion and conclusion. 30° head down tilt, as well as abdominal thrusts in the horizontal position, can drain initially more fluid from the lungs than passive drainage horizontal, but by 10 min the total amounts of fluid drained were the same. Tilt or thrusts have no significant effect on oxygenation over 6h after near drowning. Those findings do not negate the value of decompressing the distended stomach and of suctioning via tracheal tube. It appears that passive horizontal drainage during emergency resuscitation is sufficient, and that therapy after intensive respiratory therapy is what determines oxygenation and shunting more than initial fluid drainage(2). Sea water drowning causes hypovolemia (1) which calls for infusion of plasma substitute.

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References.

1. Redding J, Safar P: Resuscitation following fresh water or sea water aspiration. Acta Anaesth. Scand. Suppl IX, p.99, 1961.
2. Modell JH: The pathophysiology and treatment of drowning and near drowning. Springfield, IL, Thomas Publ., 1971.
3. Heimlich H: Subdiaphragmatic pressure to expel water from the lungs of drowning persons. Ann Emerg Med 9:476-480, 1981.

Table.

		Horizontal Control	Gravity Drainage	Abdominal Thrusts
Water drained % instilled	1'	67±27	121*±26	107*±12
	10'	105±30	128 ±22	114 ±15
Wet/dry wt RL		0.16±0.05	0.25±0.26	0.17±0.15
Wet/dry wt LL		0.31±0.43	0.14±0.05	0.16±0.08

*Signif. diff. from control ($p < 0.05$).