

Gunfight at the OK corral

Why I think the ASA NPO guidelines are a good thing

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I have no conflict of interest

Goals of my talk

- Discuss the evidence leading to the ASA guidelines
- Review the physiology of gastric emptying
- Discuss the outcomes following adherence to ASA guidelines in children



History of NPO orders

1847

- Robinson text: no guidelines; emesis was unpleasant

1883

- Sir Joseph Lister published fasting guidelines
- 2 hrs clears (tea or beef tea); no solids

1947

- *Synopsis of Anaesthesia* advocated for no food within 6hrs of anesthesia

1970

- NPO after midnight (Cohen) “NO COFFEE, NO FRUIT JUICE, NO WATER” (infants and children excluded)

1980's-
90's

- Reduction of RGV in drinking groups versus fasted groups; editorials in Anesthesiology promoting clears

1999

- ASA NPO guidelines

Purpose and focus

- Purpose of ASA guidelines:
“Provide direction for clinical practice related to preoperative fasting”
- Focus of ASA guidelines:
“Prevention of perioperative pulmonary aspiration and preparation of the patient”

ASA Guidelines 1999

Ingested Material	Minimum Fasting Period† (h)
Clear liquids‡	2
Breast milk	4
Infant formula	6
Non-human milk§	6
Light meal¶	6

* These recommendations apply to healthy patients who are undergoing elective procedures. They are not intended for women in labor. Following the Guidelines does not guarantee complete gastric emptying.

† The fasting periods noted above apply to all ages.

‡ Examples of clear liquids include water, fruit juices without pulp, carbonated beverages, clear tea, and black coffee.

§ Since non-human milk is similar to solids in gastric emptying time, the amount ingested must be considered when determining an appropriate fasting period.

¶ A light meal typically consists of toast and clear liquids. Meals that include fried or fatty foods or meat may prolong gastric emptying time. Both the amount and type of foods ingested must be considered when determining an appropriate fasting period.

ASA Guidelines 2011, 2017

- Clears: 2 hrs
 - Examples: water, fruit juice w/o pulp, carbonated beverages, tea, coffee; volume less important than type of liquid
- Breast Milk: 4 hrs
- Infant Formula: 6 hrs
- Solids and Nonhuman Milk: 6 hrs for light meal, 8 hrs (or more) for fatty meal

2-4-6-8

Rigorous process

- “Scientific evidence used in the development of these updated guidelines is based on cumulative findings from literature published in peer-reviewed journals”
- Opinion surveys: “expert consultants”
 - Majority agreed or strongly agreed on the NPO guidelines

Country, year	Requirements	Comments
ASA, 2017	<div>2 hrs clear</div> <div>4 hrs breast milk</div> <div>6 hrs formula, light meal</div> <div>8 hrs fatty meal</div>	
European Society of Anesthesiology, 2011	<div>2 hrs clear</div> <div>4 hrs breast milk</div> <div>6 hrs formula, solid food</div>	Chewing gum, Sucking hard candy okay
Canadian Society of Anesthesiology, 2014	<div>2 hrs clear</div> <div>4 hrs breast milk</div> <div>6 hrs formula, light meal</div> <div>8 hrs fatty meal</div>	
Association of Anaesthetists GB and Ireland, 2001	<div>2 hrs clear</div> <div>4 hrs breast milk</div> <div>6 hrs formula, solid food</div>	Gum chewing is treated as clears
Scandinavian Society, 2005	<div>2 hrs clear</div> <div>4 hrs breast milk and formula</div> <div>6 hrs solids and cow's milk</div>	



Splinter 1989: The effect of preop apple juice on gastric contents, thirst, and hunger in children

- NPO after midnight
- 3 ml/kg 2.5 hrs before surgery
- Less volume in stomachs after apple juice (0.24 vs 0.43 ml/kg)
- Less hunger and thirst in apple juice group

Large Volumes of apple juice

- 0, 6, 10 ml/kg apple juice 2.5 hrs preop
- No difference in gastric volumes
- Again, less thirst

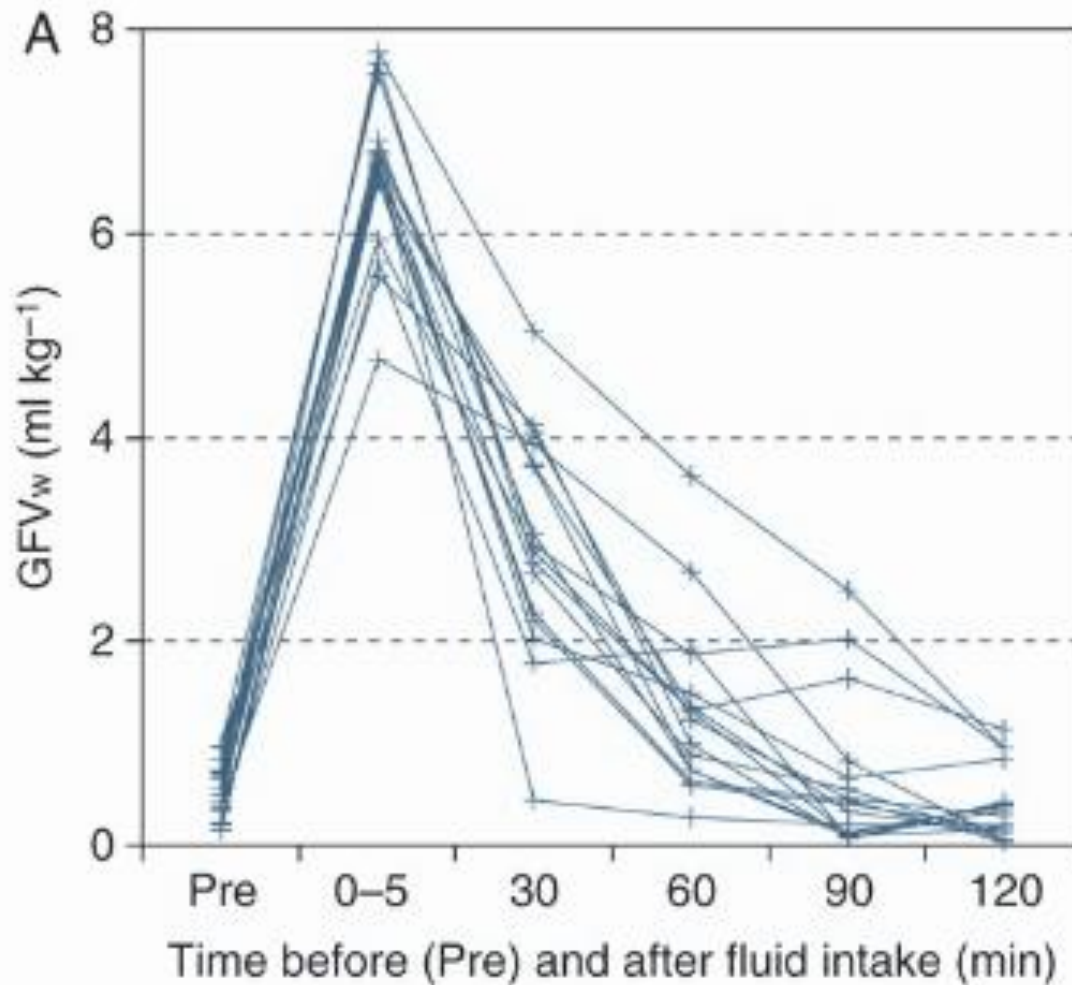
1990's: plethora of studies

- Schreiner: Anesthesiology 1990; 72: 593
 - NPO after midnight vs 2 hrs clears
 - No difference in volumes or pH

Kinetics of Emptying of Inert Liquids

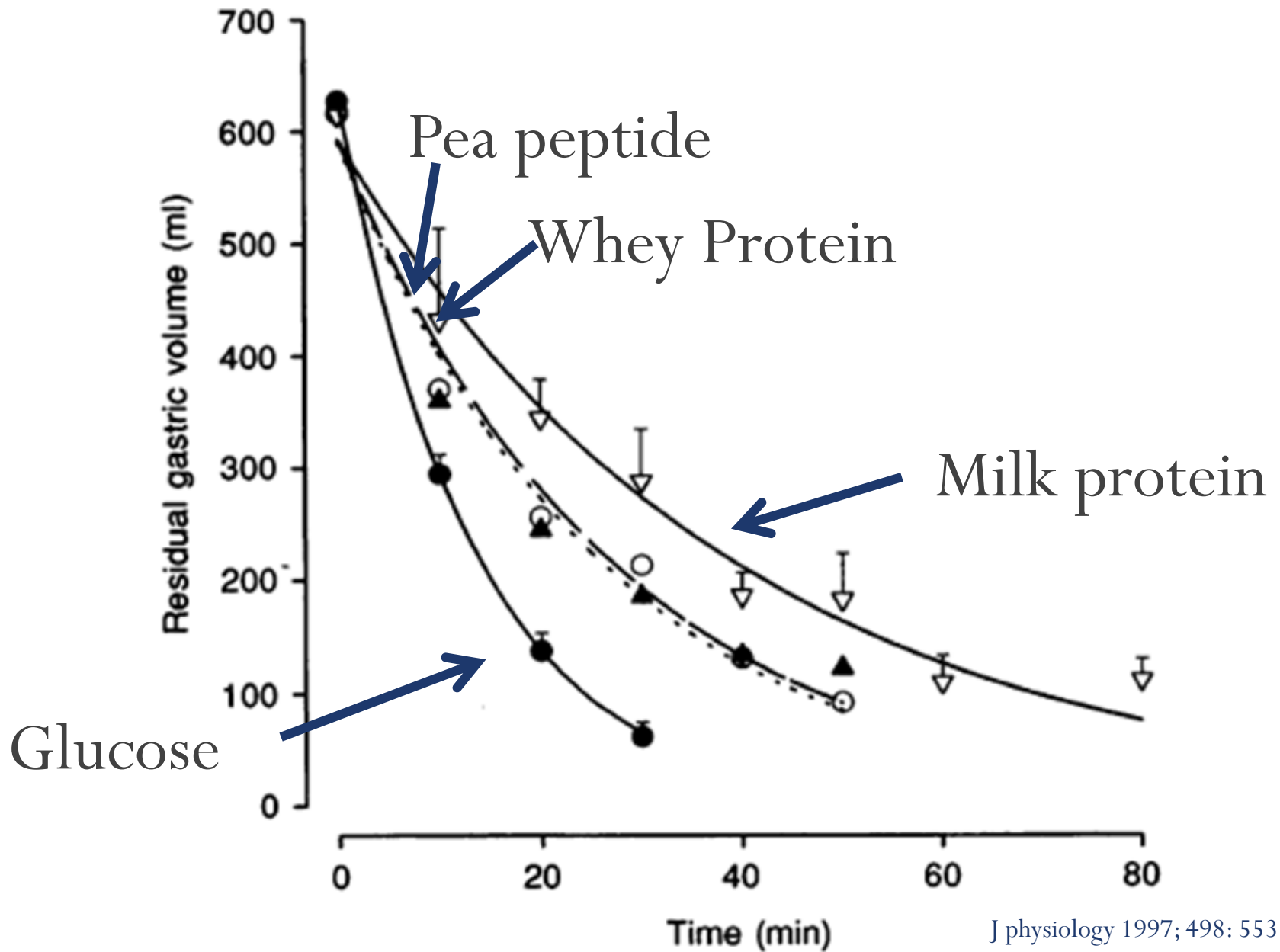
- Inert liquids: water, saline
- First order kinetics: 50% emptying time of 8-18 minutes
- Mature pattern develops by 32nd gestational week

Children: 7 ml/kg raspberry drink



How about protein drinks?





NPO vs carbs vs carbs plus amino acid: NG tube after induction

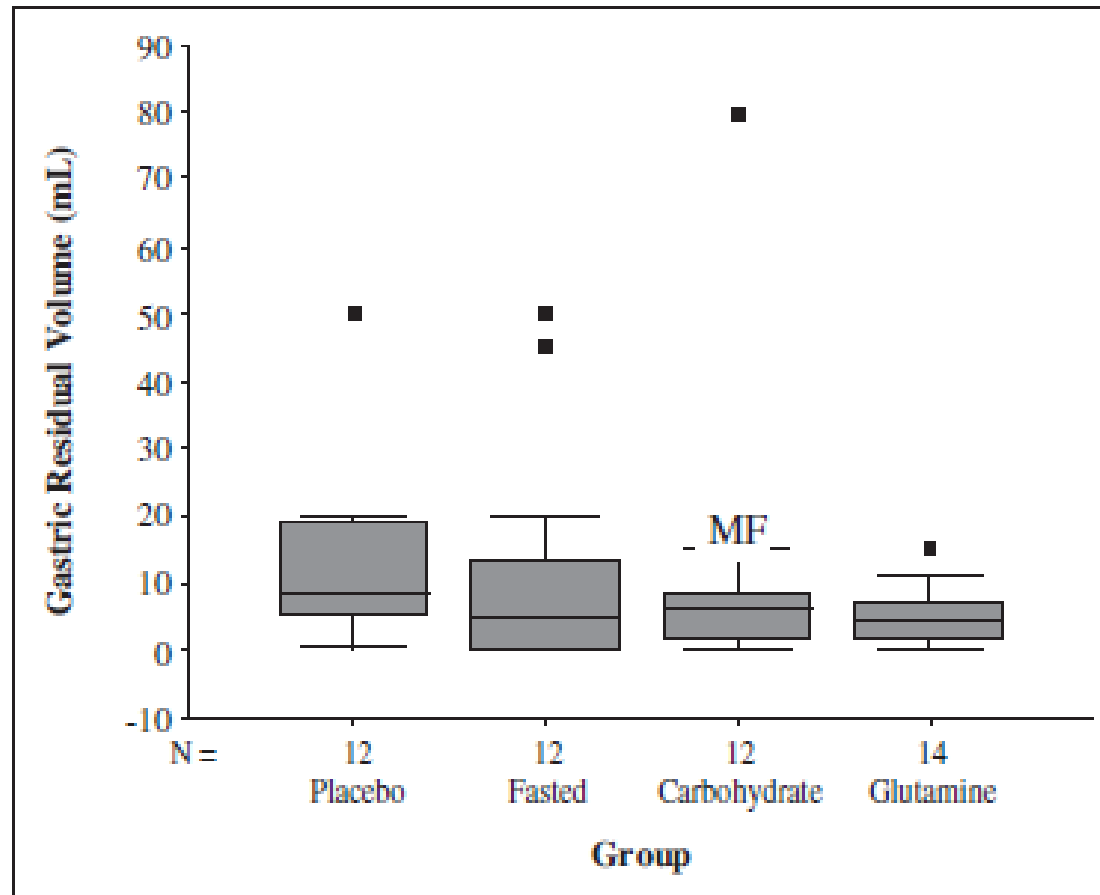
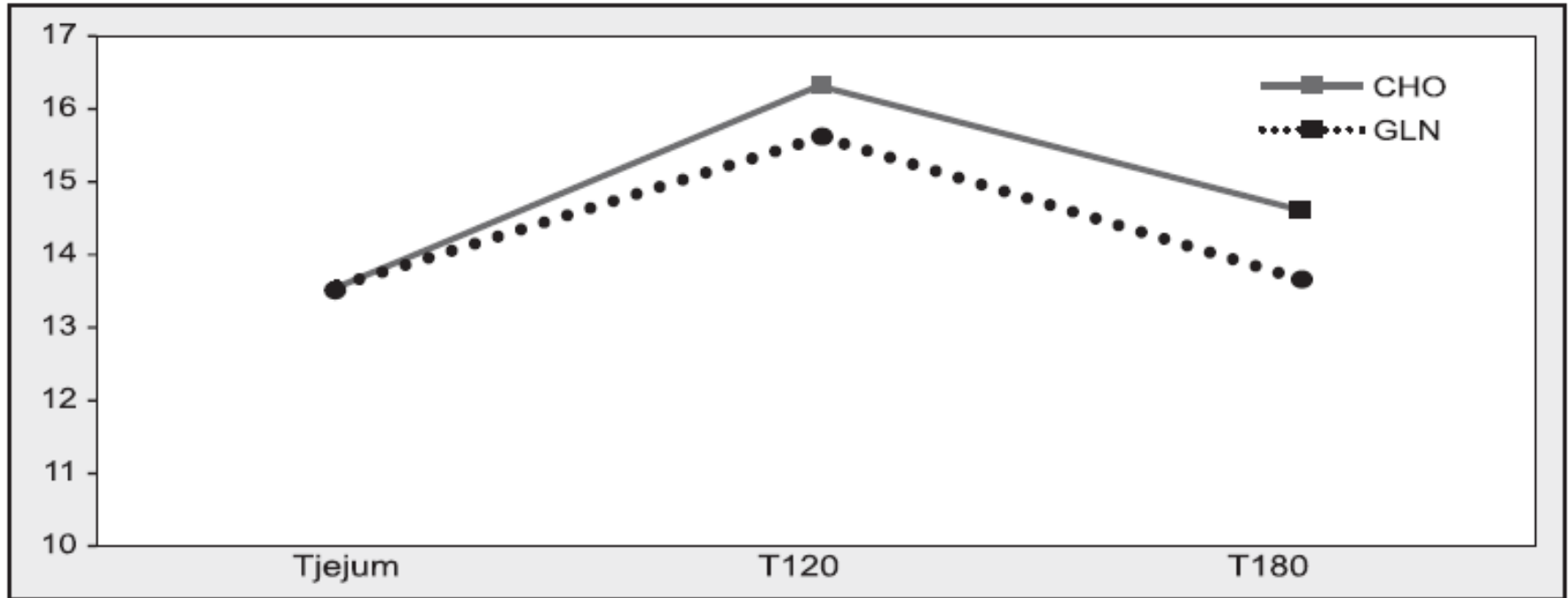


Fig. 2.—Gastric residual volume in the four groups. Data express the median, variation, and interquartile range ($p = 0.29$). Black dots are outliers.

Ultrasound: 2 and 3 hrs post carbs vs carbs plus glutamine



Breast milk = Clear Liquid?

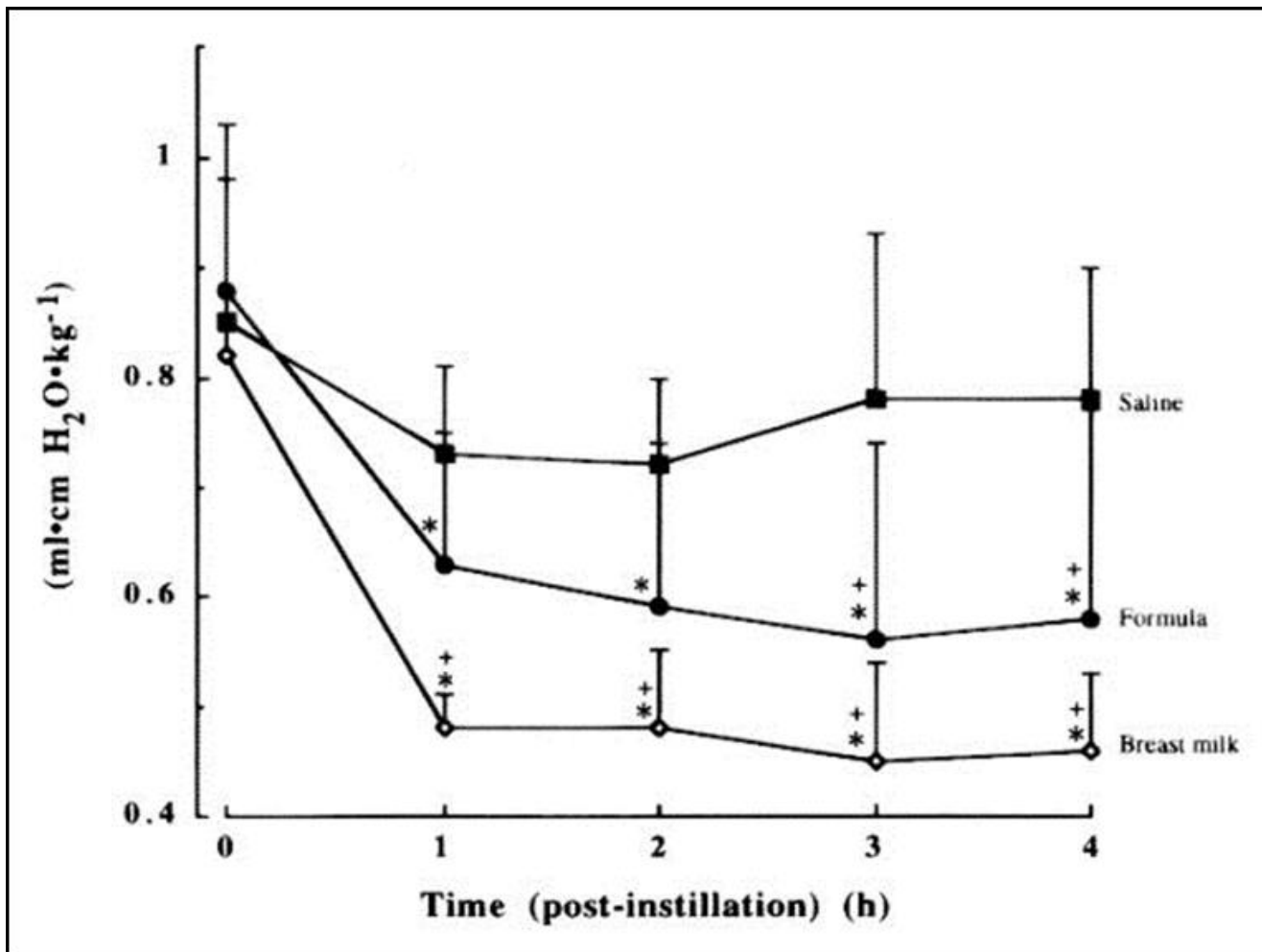
2 hrs breast milk and clears

	Clears	Breast milk
Gastric fluid recovered	10/46	8/24
Volume (mL/kg)	0.3 +/- 0.9	0.7 +/- 1.1
pH	2.1	2.6
Vol >0.4 ml/kg	8/46	8/24
Vol > 1 ml/kg	3/46	7/24

Bunny rabbit aspiration



Saline vs BM vs formula 0.8 ml/kg



Liquids: Nutritional content modifies speed

- Initial rapid phase: 5-30 minutes
- Slower second phase: constant rate up to 120 minutes
- High caloric density empties slower

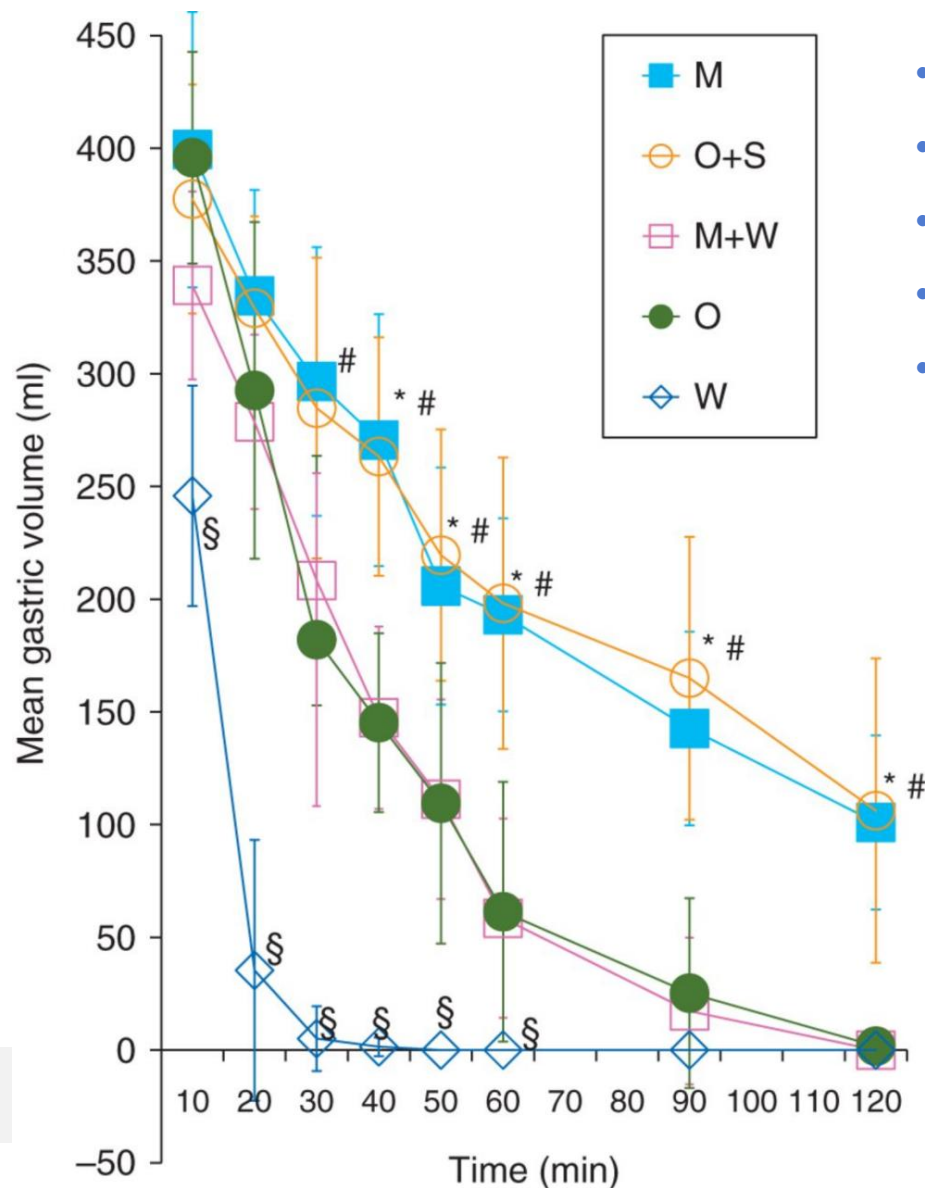
Meal volume and calorie load in MRI

- NG feeds in the MRI scanner (200, 400, 600, 800 ml)
- Ensure, 3 different calorie densities

Calorie Load	200 ml	400 ml	600 ml	800 ml
200 kcal	56	41	42	38
300 kcal	74	59	60	56
400 kcal	92	77	78	74

Gastric Contents Half-empty times (min)

Determinants of liquid gastric emptying: comparisons between milk and isocalorically adjusted clear fluids: 500 ml

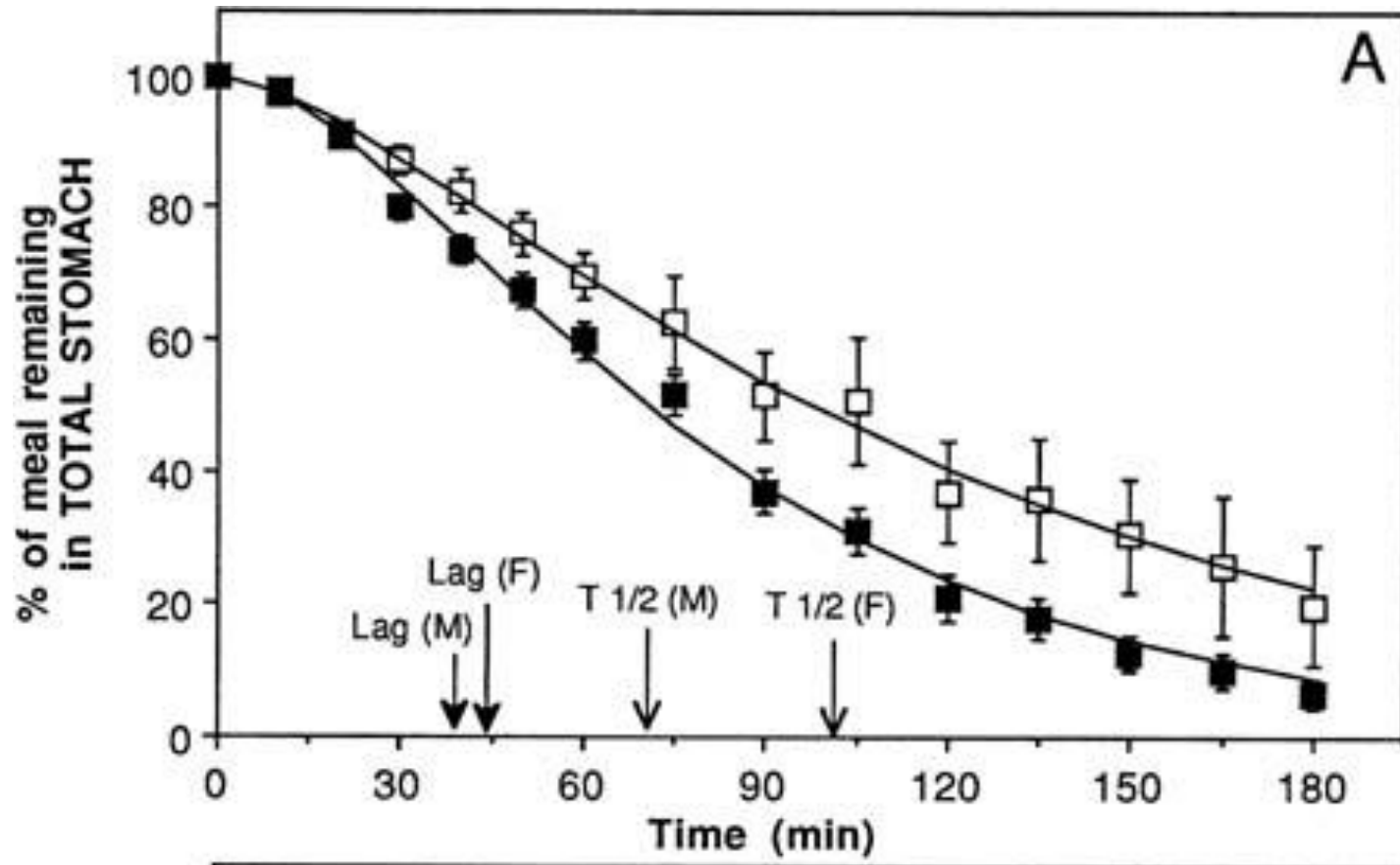


- M: Milk (330 kcal)
- O+S: Orange juice/syrup (330 kcal)
- M+W: Milk/water (220 kcal)
- O: Orange juice (220 kcal)
- W: Water

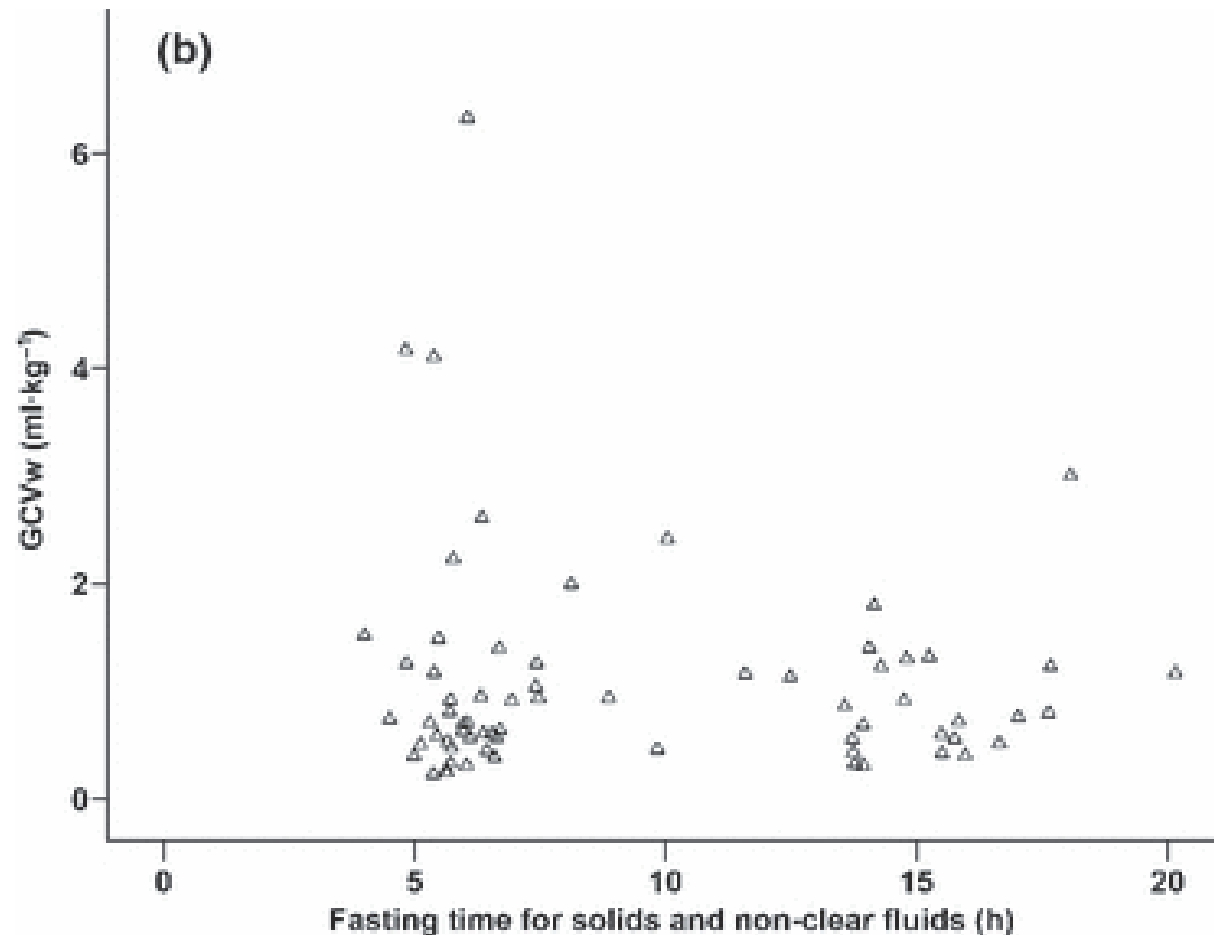
Date	Ingestion time	Stomach contents	View time	Stomach contents	View time	Stomach contents	Time to empty
March 13	13:00	Roast beef, bread potatoes	16:30	Chymification complete	18:00	Gastric juice only, tinged with bile	5.0 hr
March 14	12:00	Milk 500 mL, bread 120 g	12:30	Milk coagulated, bread soft pulp, fluid	14:00	Almost empty	2.0 hr
March 15	08:15	Sausage, light pancakes, coffee 500 mL	09:30	Full of fluid mixed with food	12:00	Gastric juice only	3.75 hr
March 16	08:30	Fresh meat, vegetable hash, bread, coffee 500 mL	10:30	Few food particles, oil and fluid	11:00	Little gastric juice	2.5 hr
March 16	14:00	Lean beef, pork, potatoes, carrots, turnips, bread			17:00	White frothy mucus, no food	3.0 hr
March 18	09:00	Soused tripe, pig's feet, bread, coffee	09:30	All food half digested, reduced to pulp	10:00	Little gastric juice, few fibrous particles	1.0 hr
March 18	13:00	Calf's-foot jelly 250 g	13:20	Few jelly particles floating in fluid	14:00	Little fluid, no jelly	1.0 hr
April 7	08:00	Hard-boiled eggs (3), pancakes, coffee	08:45	About half digested	10:15	Stomach empty	2.25 hr
April 7	11:15	Roasted eggs (2), ripe apples (3)	11:45	Heterogeneous mixture	12:15	Stomach empty	1.0 hr
April 7	14:00	Roast pig, vegetables	15:00	Half chymified	16:30	Very little gastric juice	2.5 hr
April 8	14:00	Wild goose	15:00	Floating oil and shreds of flesh	16:30	Stomach empty	2.5 hr
April 9	15:00	Boiled dried cod, potatoes, parsnips, bread, butter	16:30	Completely chymified	17:00	Stomach empty	2.0 hr

Emptying of Solids in the Stomach

- Gender difference
- Holding pattern for first hour (digestion)



2 hrs clears; 4 hrs other fluids, light meal for
GA or sedation spont ventilation



- Mendelson 1946

- Instillation of HCL or vomitus from a pregnant woman into rabbits

- Roberts 1974

- Injection of acid into a monkey's trachea
- Gastric volume >25 ml, $\text{pH} < 2.5$

Pediatric Aspiration Papers

- Olsson et al, 1986: retrospective; 0-9 years 9/10,000
- Borland 1998: retrospective; 10.2/10,000
- Warner x5, 1999: prospective over 12 yrs; 2/10,000 for elective cases; 25/10,000 emergency
- Walker, 2013: UK prospective multicenter trial; 2/10,000
- Tan and Lee, 2016: retrospective over 13 years; 2/10,000

So—adherence to guidelines appears to minimize aspiration



Shortened NPO period?

- 15 yo who sputtered and became cyanotic
- Developed rattling in her throat and passed away
- Sir James Simpson 1848: aspiration of preoperative water and brandy

Shortened NPO period?

- Clears until “called into the OR”
- Retrospective review of 9889 pediatric patients from 2008-2013
- 3 confirmed cases of aspiration
- 14 cases of suspected aspiration (“rales, desaturation”)
- Incidence of 17/9889; much higher than other studies

ERAS

Preparing enhanced recovery after surgery
(ERAS) for implementation in pediatric
populations

Leeds et al. J Ped Surgery 51; Dec 2016

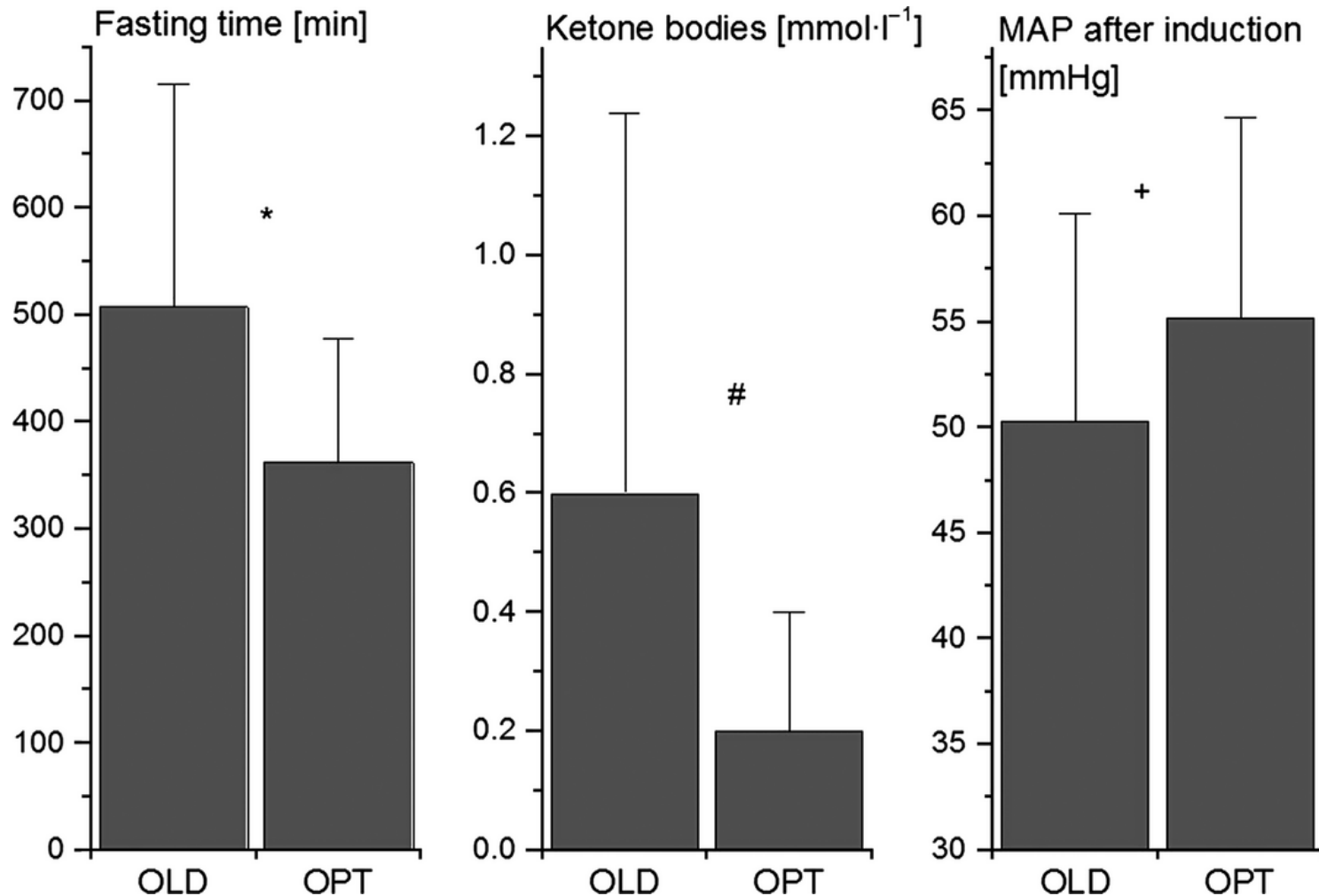
Beneficial?

10 ml/kg 12.6% carbohydrate soln night before and 2 hrs preop

	Carbohydrate Load	Control
Preop Glucose	84	81
Preop Insulin	2.87	5.39
Postop Insulin	6.61	9.88
Postop Glucose	124	104

- Insulin resistance postop: 0.62 vs 2.0!!

Improve ketone bodies/MAP



NOT the wild wild west in preop!
Hydrated, happy children



Summary

- ASA guidelines provide guidance for parents / surgeons / anesthesia providers
- Based on studies / expert opinion / physiology
- Minimizes aspiration while improving satisfaction and well-being