AMERICAN COLLEGE OF EMERGENCY PHYSICIANS

SCIENTIFIC ASSEMBLY

1999

Acid-Base Workshop

With only a minimum of laboratory data, the clinician can usually narrow the differential of acid-base problems to a workable few. Using well-established principles and formulas, this course will help the emergency physician work through common problems.

- Develop a practical differential for acid-base problems.
- Use the electrolyte panel and arterial blood gas to categorize acid-base problems.
- Use a few simple formulas to narrow the differential.

TU-106
Tuesday, October 12, 1999
4:00 PM - 4:55 PM
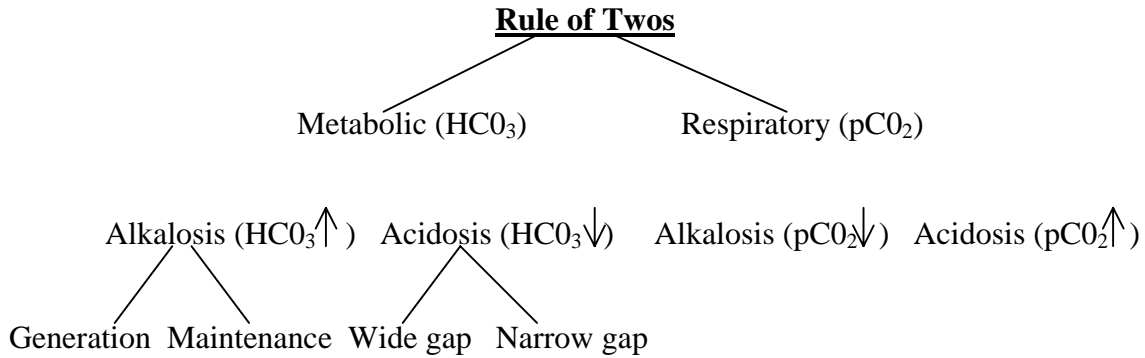Room # N223
Las Vegas Convention Center

FACULTY

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Acid-Base Workshop

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Rule of Twos

Metabolic (HC0$_3$)   Respiratory (pC0$_2$)

Alkalosis (HC0$_3$↑) Acidosis (HC0$_3$↓)   Alkalosis (pC0$_2$↓) Acidosis (pC0$_2$↑)

Generation Maintenance Wide gap   Narrow gap

The Bottom Line Approach

- Look at all the numbers
- Calculate the Anion Gap (A.G.)
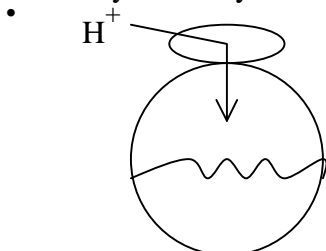- Know 2 mnemonics
- Know 5 formulas
- Keep it simple

A 35 Year Old Alcoholic

- N, V, Abdominal pain, SOB, AMS
- 100/60, 120, 28, 100, 99%

140	100	28	90
3.8	10	1.0	
	A.G. =		
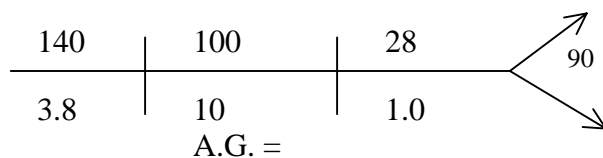
Wide Anion Gap

- Na - (Cl + HCO$_3$)
- Normal < 15
- Always Primary
- H$^+$

Methanol
Uremia
DKA/AKA
Paraldehyde
Iron, Isoniazid
Lactic acidosis
Ethylene glycol
Salicylate

A 35 Year Old Alcoholic

- N, V, Abdominal pain, SOB, AMS
- 100/60, 120, 28, 100, 99%

```
140   |   100   |   28          ↗
_____|_____|_____  90
3.8   |   10    |   1.0          ↘
          A.G. = 30
```

Methanol/E.G. v. AKA

- Rare
- Alcoholics, Teens, Military
- Blind-late, ARF-late
- ↑ Osmolar gap (OG)
- Potentially lethal

- Common
- Binging alcoholic only
- No specific S/S
- No - very small ↑ OG
- Usually pretty benign

Osmolar Gap (OG)

- OG = Measured osmo - Calc osmo
- Calc osmo = 2Na + Bun/2.8 + Glu/18+ETOH/4.2
- Normal < 15, usually < 10 mosm
- Wide gap acidosis + ↑ OG = Methanol/E.G.
- Ketosis w/out acidosis + ↑ OG = Isopropyl

```
140 | 100 | 28      ↗                140 | 100 | 28      ↗
____|_____|____      90              ____|_____|____      90
3.8 | 10  | 1.0     ↘                3.8 | 10  | 1.0     ↘
```

A.G.	= 30		
ETOH	= 0	A.G.	= 30
M. OSMO	= 345	ETOH	= 210
C. OSMO	= 295	M. OSMO	= 345
O.G.	= 50	C. OSMO	= 345
Methanol / E.G.		O.G.	= 0
		AKA	

Methanol/E.G. versus AKA
Treatment

- ETOH drip
- Dialysis
- 4-MP
- Thiamine/Pyridoxine/
  Folate

- D_5NS
- Mg^{++}
- Thiamine, Folate, Niacin
- Feed

M
U - Bun >50
D - >250, $\oplus$ urine ketones
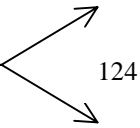I - Kids, x-ray, Serum Fe >350
I - Status sz, tb risk, SE Asian
L- Shock, Bacterial overgrowth
E
S - Occult, mimics sepsis/CHF, Salicylate level

25 y.o. with Spina Bifida

- Fever
- N/V

140	115	30
5.5	15	1.8

124

A.G. = 10

Narrow Gap Acidosis

- H^2
- A
- R
- D
- U
- P^2

Narrow Gap Acidosis

- H-yperventilation (Chronic)-pH alkalotic
- H-yperalimentation (rare)-central IV with TPN
- A-cetazolamide-mountains, ophtho
- RTA-urine pH $\geq$ 7
- Diarrhea-you'll see it
- Ureteral Diversion-abdominal scar with bag of urine
- Pancreatic Fistula-prior history
- Parenteral Saline-lots

Narrow Gap Acidosis

- May be Primary or Compensatory (Resp. Alkalosis)

$HC0_3$ (gut, kidney)
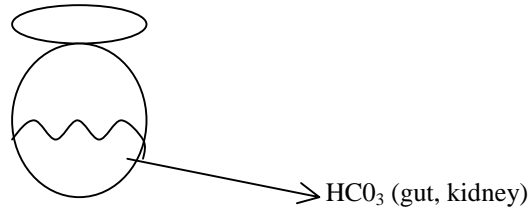
K+ and Acidosis

- No Formulas!
- If serum K ↑ - Total body K ??
- If serum K Normal - Total Body K ↓
- If serum K ↓ - Total body K ↓ ↓ ↓
- Replace early

Phosphorus and Acidosis

- If serum Phos ↑ - Total body Phos ??
- If serum Phos normal - Total body Phos ↓
- If serum Phos ↓ - Total body Phos ↓ ↓ ↓
- Replace when < 1.0

18 y.o. Girl with Syncope

- Cachectic
- 90/50, 60, 12, 95, 100%

128	74	30	64
3.0	40	1.4	

Metabolic Alkalosis

- Meq/L for meq/L, worse than metabolic acidosis

$HC03$
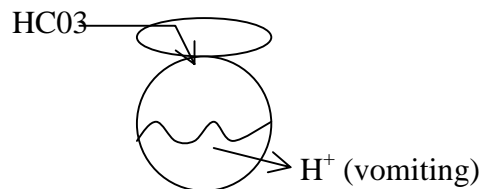
H^+ (vomiting)

Metabolic Alkalosis

Generation

1. Loss of Acid
   * UGI (Vomiting)
     LGI
   * Intracellular ($\downarrow$ K)
2. HCO_3 addition
*3. Contraction
4. Posthypercapnea

Maintenance

1. $\uparrow$ Vol. Contraction
2. $\uparrow$ pCO_2
3. $\downarrow$ K
4. $\downarrow$ Mineralocorticoids

Metabolic Alkalosis

- 95% of time, cured by normal saline
- Saline - resistant - think endocrine disorder (renin/aldosterone)
- Limits of compensation (pCO_2 55-60)

ABG

- $\uparrow$ pCO_2 of 10 = $\downarrow$ pH of 0.8 <u>acutely</u>

- $\downarrow$ pCO_2 of 10 = $\uparrow$ pH of 0.8 <u>acutely</u>

Compensation

- Compensation for metabolic disorder - quick
- Compensation for respiratory disorders - slow
- **NEVER OVERCOMPENSATE**
- pH always in direction of Primary disorder

$pCO_2 \downarrow$ pH $\uparrow$ -   Respiratory Alkalosis

$pCO_2 \downarrow$ pH $\downarrow$ -   Metabolic Acidosis

$pCO_2 \uparrow$, pH $\uparrow$ -   Metabolic Alkalosis

$pCO_2 \uparrow$, pH $\downarrow$ -   Respiratory Acidosis