Safe and Effective Use of CO2 Absorbents

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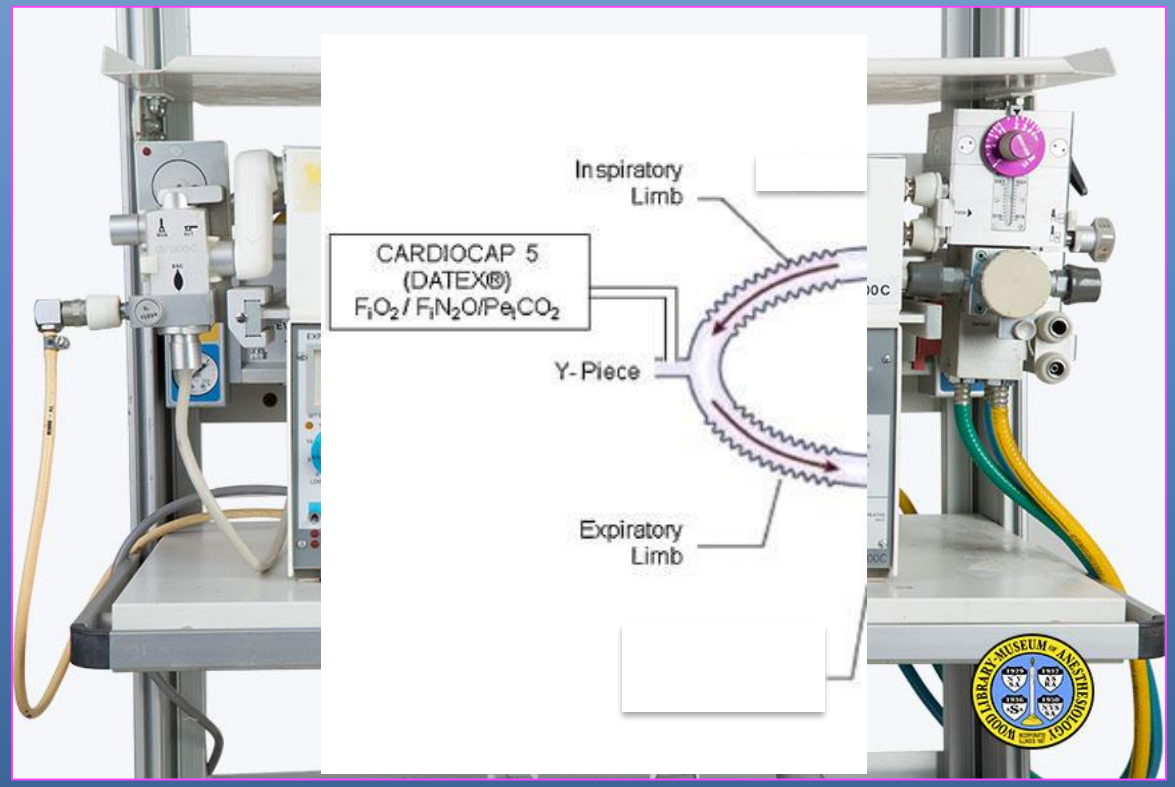
Disclosures

- Consulting
  - ClearLine MD
  - Draeger Medical

Safe & Effective Use



Are CO2 Absorbents Safe?

- Exothermic Reaction Can Cause Fire
  - Sevoflurane
  - Requires dessicated Baralyme
  - Strong base KOH – Baralyme no longer available
- Compound A Production
  - Sevoflurane
  - Strong Base
  - Clinical relevance?
  - Clinical practices influenced by min flow recommendations
- Carbon Monoxide Production
  - Desflurane > Isoflurane> Sevoflurane
  - Dessicated absorbent is required
  - Strong Base: NaOH, KOH
  - Clinical practices to prevent dessication continue

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THE OFFICIAL JOURNAL OF THE ANESTHESIA PATIENT SAFETY FOUNDATION
Volume 9, No. 2 • Summer 1994

Articles

Cause Of CO Poisoning, Relation To Halogenated Agents Still Not Clear

www.apsf.org

NEWSLETTER

The Official Journal of the Anesthesia Patient Safety Foundation

Volume 20, No. 2, 25-44 Circulation 75,648 Summer 2005

Carbon Dioxide Absorbent Desiccation Safety Conference Convened by APSF

What did we know then?

- Absorbent dessication produced CO
  - Turn off fresh gas flows between cases
  - Change absorbent regularly eg. Mon Morning
  - Change when color indicates “exhaustion”
- Presence of Strong Base increased both CO and Compound A
  - KOH is the worst
  - NaOH a contributor

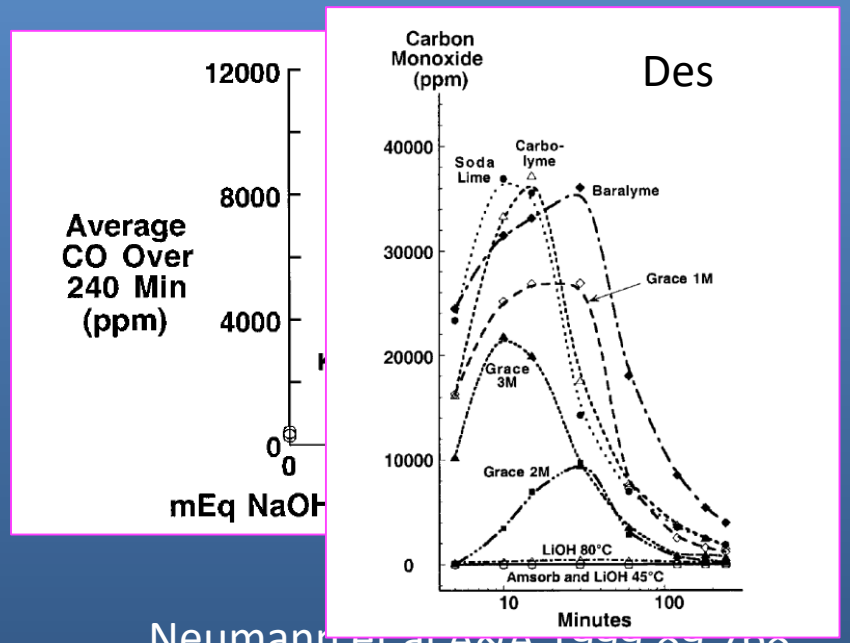
“create an “Expert Task Force” to define further the characteristics of carbon dioxide absorbents that do not significantly degrade volatile anesthetics”

What have we learned?

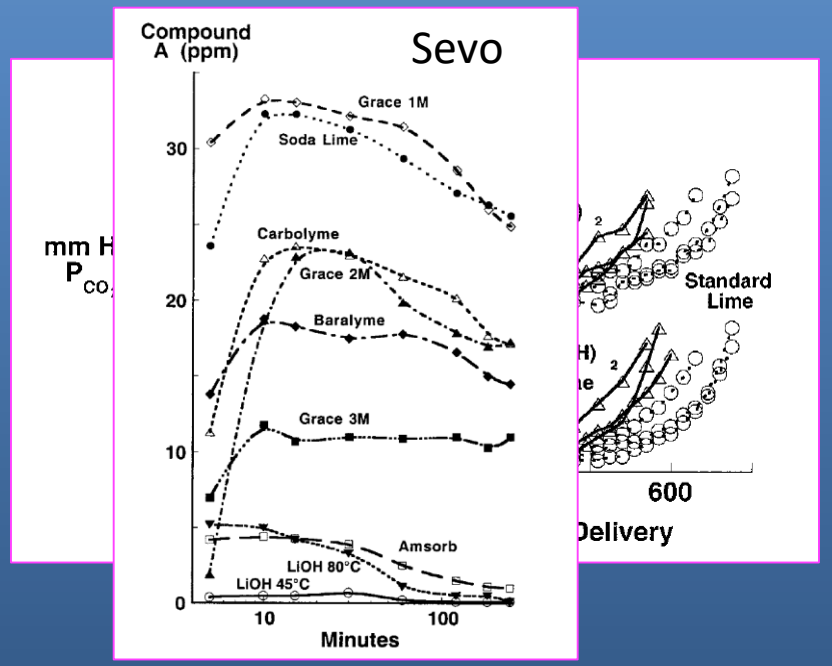
- Absorbent Formulations have Evolved
  - Goals
    - Minimize or eliminate anesthetic degradation to CO and Compound A
    - Maximize absorptive capacity
  - Reduce or eliminate strong base catalysts – KOH, NaOH
  - Develop alternate chemistry – LiOH, LiCl, $CaCl_2$, $CaSO_4$
- Technology Changes
  - Absorbent Canister designs

Is there an optimal formula?

- No KOH, Reduced or no NaOH
- Efficiency decreases
- Price may increase



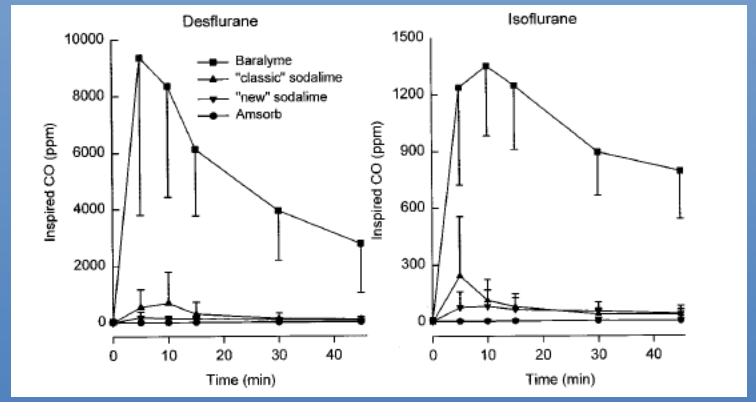
Neumann et al A&A 1999;89:768.

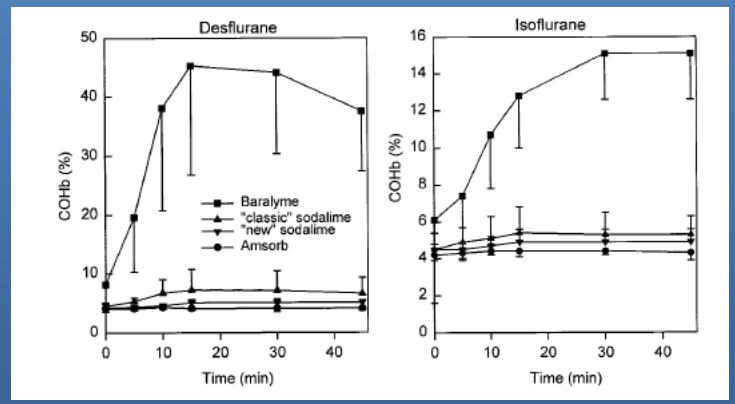


Stabernak et al. A&A. 2000:90;1428

In–Vivo Data CO – Des/Iso

Absorbent	% KOH/NaOH
Baralyme	4.6/0
Soda Lime	2.6/1.3
New Soda Lime	0/2.6
CaOH	0/0





Kharasch et. al. Anesthesiology 2002;96:173.

Sevoflurane Data

NaOH

Table 2

Areas under the curve (AUCs, p.p.m. min) of compound A (CA) and carbon monoxide (CO) based on the mean concentrations from the duplicate experiments of each desiccated and normally hydrated carbon dioxide absorbent used in combination with sevoflurane 0.8%.

CO_2 absorbent	AUC-CA-d	AUC-CA-f	AUC-CO-d	AUC-CO-f
Drägersorb 800 plus®	351	1695	4516	0
Medisorb®	327	1228	1452	0
Spherasorb®	294	301	1866	0
Loflosorb®	0	0	0	0
Superia®	0	0	0	0
Amsorb®	2937	0	0	0
Lithium hydroxide	396	0	0	0

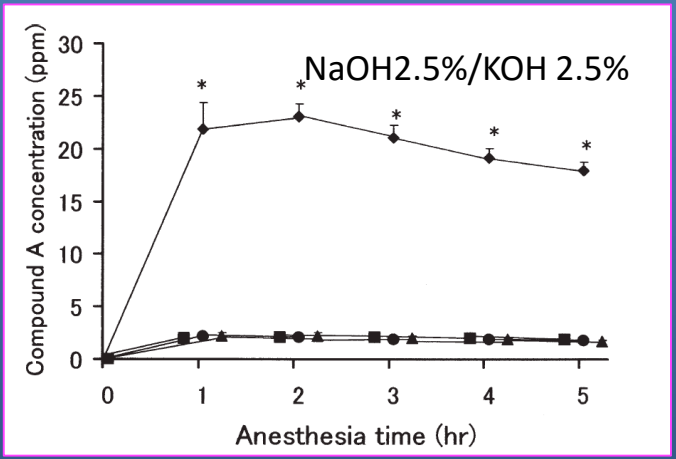
d, desiccated absorbent; f, normally hydrated absorbent.

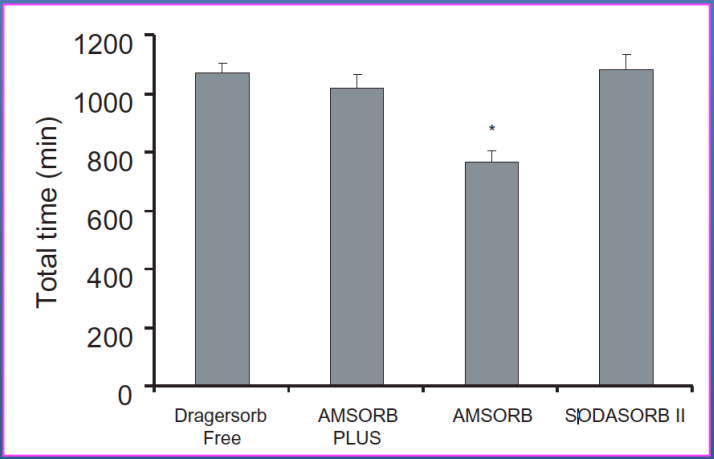
No NaOH

Keijzer C, et. al. Acta Anaesth Scand 2007;51:31.

Is NaOH OK?

- Draegersorb Free (NaOH<2%) v Amsorb Plus (NaOH=0%)
- Struys 2004 – In vitro, FGF 500
  - Compound A < 1 ppm
  - No CO when dessicated with Des
- Kobayashi 2004 – In vitro FGF 1000





NaOH and Absorption Capacity

Product	NaOH	Mins/100g to 0.5% FiCO2
Amsorb Plus	0	56
Litholyme	0	59
Sodasorb LF	<1%	66
Draegersorb Free	<2%	69
Sodasorb	<4%	78
Draegersorb 800+	2 %	91
Spirolith CA	<1%	95

Hendrickx, J. Submitted for Publication 2018 – In Review. Personal Communication.

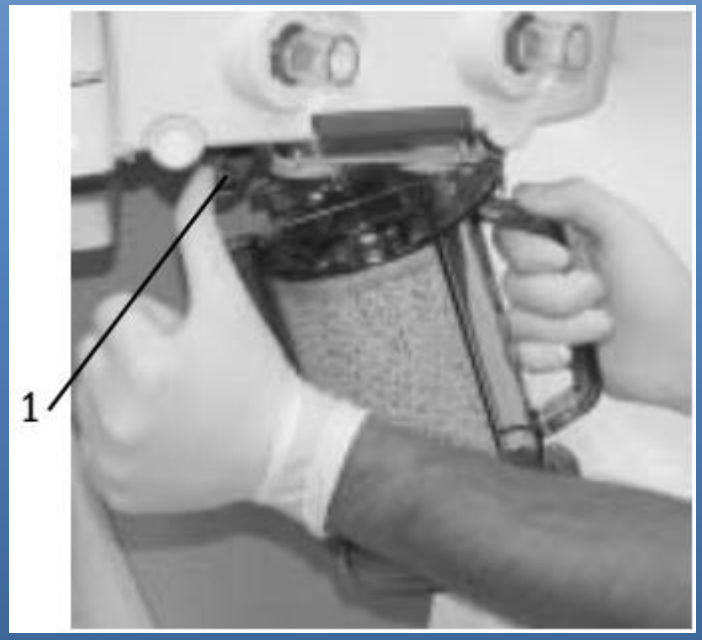
Safe Absorbent Use

- No Dessication, No CO
- No Sevoflurane, No Compound A
- Selection of Absorbent can eliminate these concerns
  - Minimize or eliminate strong base
  - Options readily available so not a limitation in modern practice
  - Absorbent capacity depends upon presence of strong base
- Modern absorbents support more effective practice

Effective Absorbent Use

- Clinical Comparison is Difficult
  - Cost Differences – loose fill, canister design, product
  - How do you change absorbent?
  - What fresh gas flows do you use?
  - What is the patient population?
- Efficiency: How much CO2 is absorbed per canister
- Efficiency is driven by when you change the absorbent.
  - Schedule irrespective of indicator
  - Indicator change
  - Inspired CO2

Change on Inspired CO2



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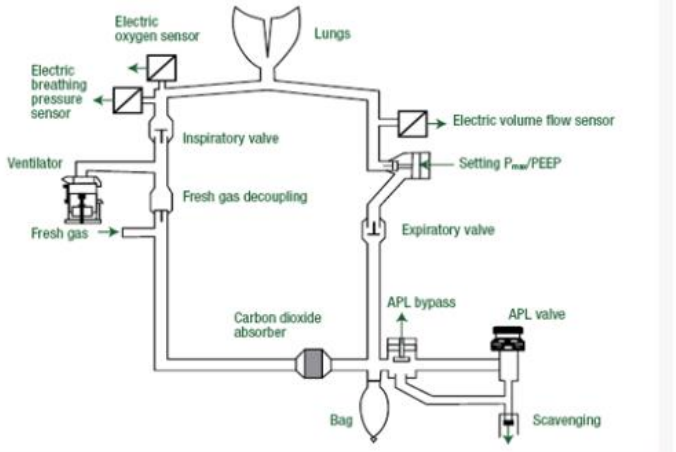
Articles

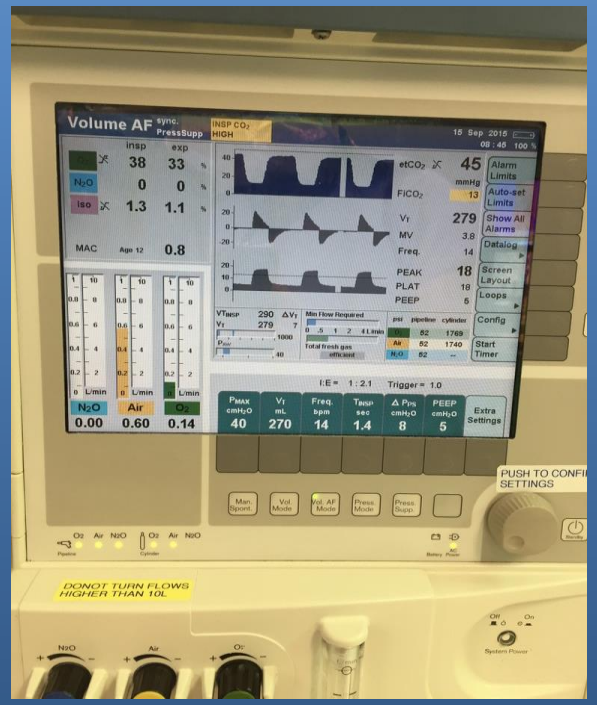
Exchanging A CLIC Absorber In The Middle Of The Surgery

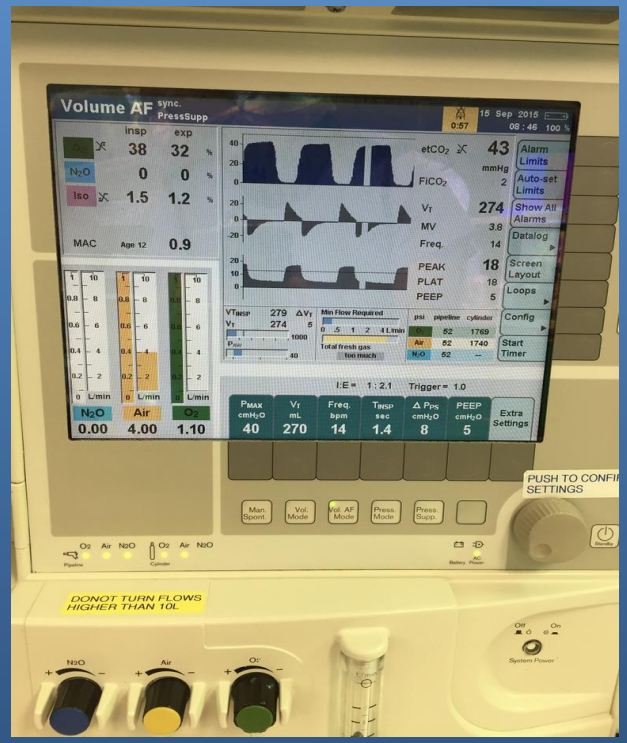
Yuki Kuruma, MD; Yuya Kita, CE; Shigehisa Fujii, CE



Change on CO2

- Capnography
- Use of FGF to determine cause of problem
- What level of CO2 to trigger change? 5-10 mmHg?





Is Change on CO_2 Safe?

- Special populations eg neurosurgery or pulmonary hypertension
  - – $PaCO_2$ is most important
  - – Change on indicator or Monitor CO_2
- Circuit Leaks
  - – Bypasses the leak test
  - – Vigilant to detect leaks – exclude canister, set FGF > MV
  - – Need a process for testing canisters independently for leaks before replacement

2018 Recommendations

- Choice of Absorbent
  - No KOH
  - NaOH < 2% or NaOH = 0 ?
    - CO possible with dessication and Desflurane
    - Compound A possible – clinical relevance?
    - Absorbent capacity is the key difference but change on indicator alone erodes efficiency advantage
  - Select packaging that supports change on CO_2
- Fresh Gas Flow
  - Turn off between cases
  - Low flow techniques prevent dessication
- Use the Anesthesia Machine!
  - Reduce FGF to conserve Agent and Maximize CO2 absorption
  - No limitation on minimum flow
  - Change Absorbent on Inspired CO_2 maximally uses absorbent
    - Concentration: 5 mmHg
    - Know how to manage leaks
    - Need a process for leak testing