DKA Fluid Controversies

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No Disclosures

Objectives

- Will touch base over some basic DKA knowledge
- Explore current management strategies
- Question why is it of importance
- Share evidance and future prospectives

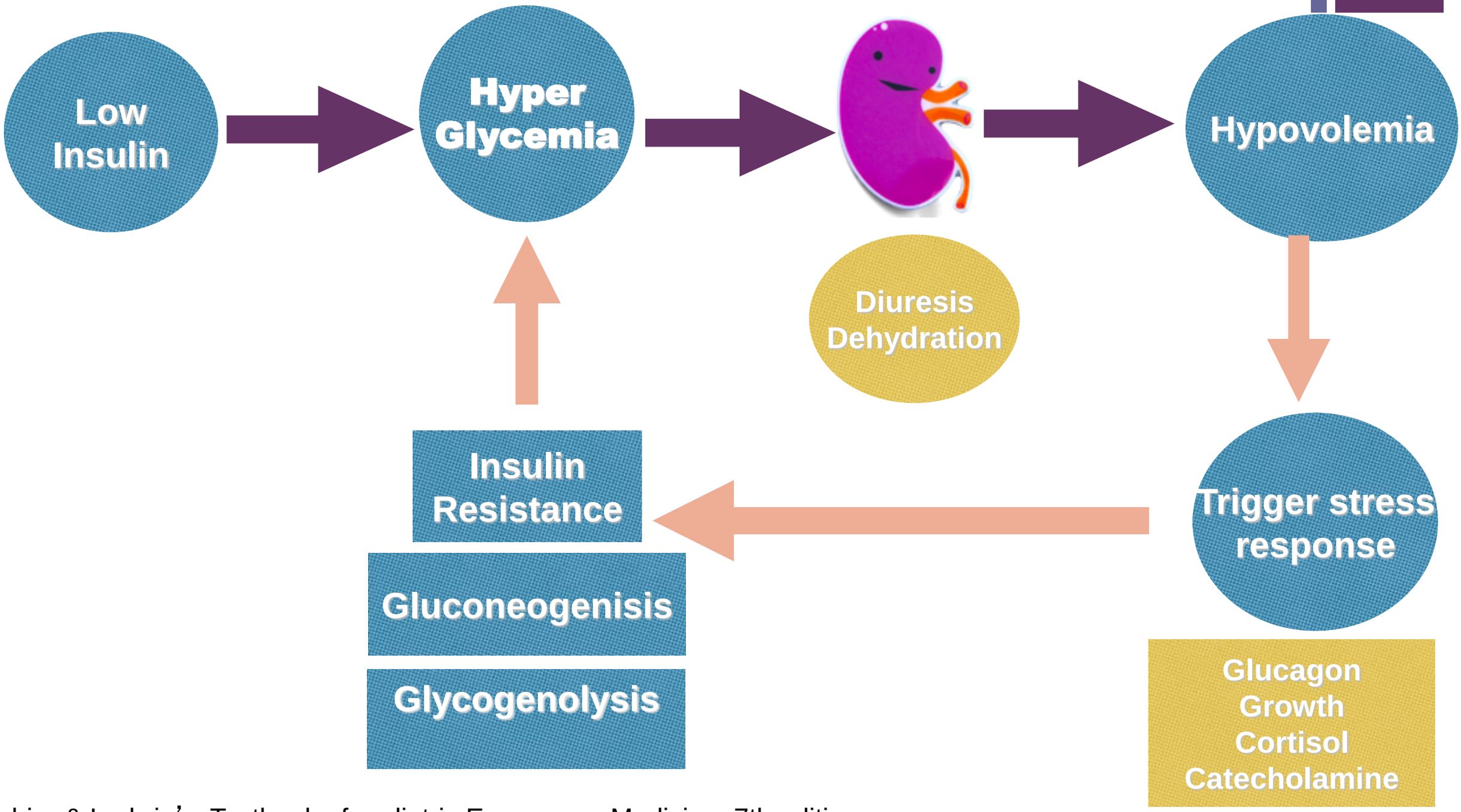
DKA Definition

- Hyperglycemia: Glucose > 200 mg/dl
- PH < 7.3 and/or
- Bicarbonate 15 meq/L or below *
- Ketonemia/ketonuria

Epidemiology

- Type1DM is 1–10% per patient per year
- 15-83% of new onset DM present in DKA
- 64% of all deaths in kids with DM associated with DKA
- 83-97% deaths due to DM are caused by DKA

Pathophysiology



Fleshier & Ludwig's Textbook of pediatric Emergency Medicine, 7th edition

DKA Management

Underlying Pathology

Insulin

Fluid

Electrolytes

Fluid Management

- Volume expansion
- Sodium replacement
- Improve glomerular filtration
- Reduce the risk of ***cerebral edema***


SHOW of HANDS

BSPED Guideline 2015

- Initial Fluid: Maximum 10ml/kg
- Maintenance: Reduced volume rule

1st 10 kgs 2ml/kg	**10-40 kgs 1ml/kg**	**40 kgs and above 40ml/hour**

- Deficit evenly over 48 hours
- Deduct initially hour IVF if used > 20ml/kg

ISPAD Guideline 2014

ISPAD
International Society for Pediatric and Adolescent Diabetes

- 1st hour IVF: No mention of rate
- Aim to restore circulation
- Maintenance and deficit evenly not to exceed 1.5-2 times maintenance /day

North American Guidelines

Both has no specific IVF rate

in the first hour !

Canadian Hospitals Guidelines

BC CHILDREN'S HOSPITAL

SickKids

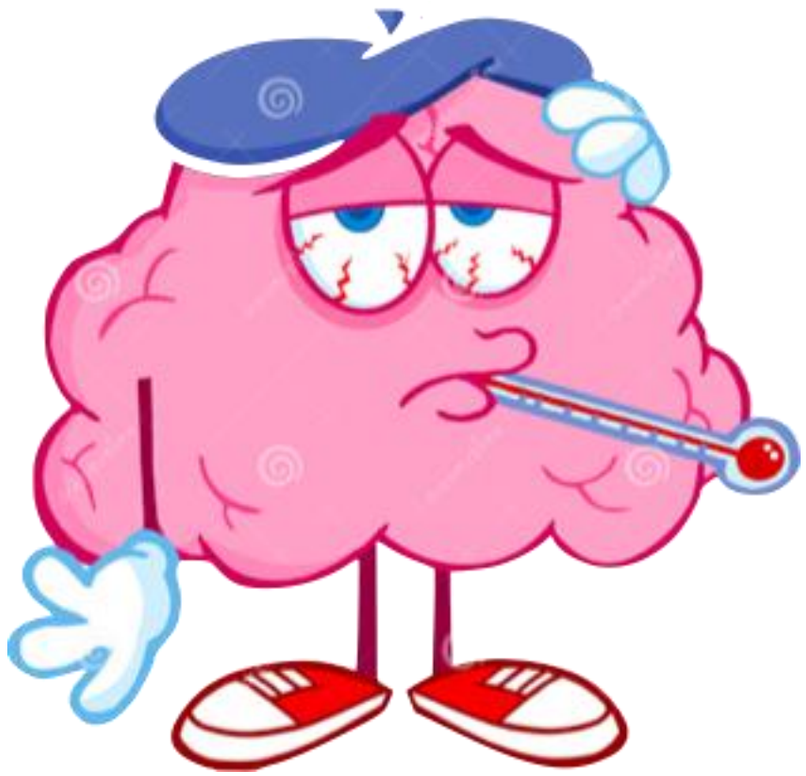
- 5-10 ml/kg/hour 7 ml/kg/hour
- Deficit is Evenly distributed over 48 hour

Fluid Management Dilemmas

- Bolus vs 10 ml/kg/hr
- Deficit (50% over 8 hours then the rest over 16 hours) vs equal distribution over 48 hours
- Deficit estimation methods
- Deduction of first hour fluid from deficit
- K+ replacement

Why is it a BIG deal ?

Risk of Cerebral Edema (CE)



Cerebral Edema 2ry to DKA

- Occurs in 0.5-1% of DKA cases (overt)
- Up to 40% mortality
- Survivors will have neurological

Subtle Cerebral Edema

- Occurs up to 50% of DKA cases
- GCS <15 if there is ventricular narrowing 55%
- MRI Spectroscopy measure metabolites

Why does CE occurs in DKA ?

- Aggressive fluid therapy

(Iatrogenic)

- Fluid shift by osmotic changes

were the main reason of DKA CE

NOT well supported by evedince

Understanding CE in DKA

- Krane et al, CT of asymptomatic patients showed decreased ventricular size during treament
- Hoffman et al, CT showed decreased ventricular size prior to and during management compared to recovery

Understanding CE in DKA

- 40% DKA patient with profound neurological disturbance Dx CE had normal initial CT scan.
- Repeated imaging showed Edema, Hemorrhage or Infarction

Muir et al, Diabetes Care 2004

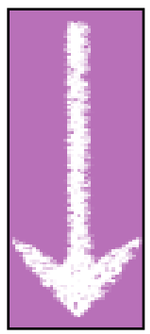
Understanding CE in DKA

- CE risk factors:
- ↑ BUN
- ↓ CO2
- Sodium change
- Treatment with Bicarb

Dehydration

+

Acidosis



Cerebral poor perfusion

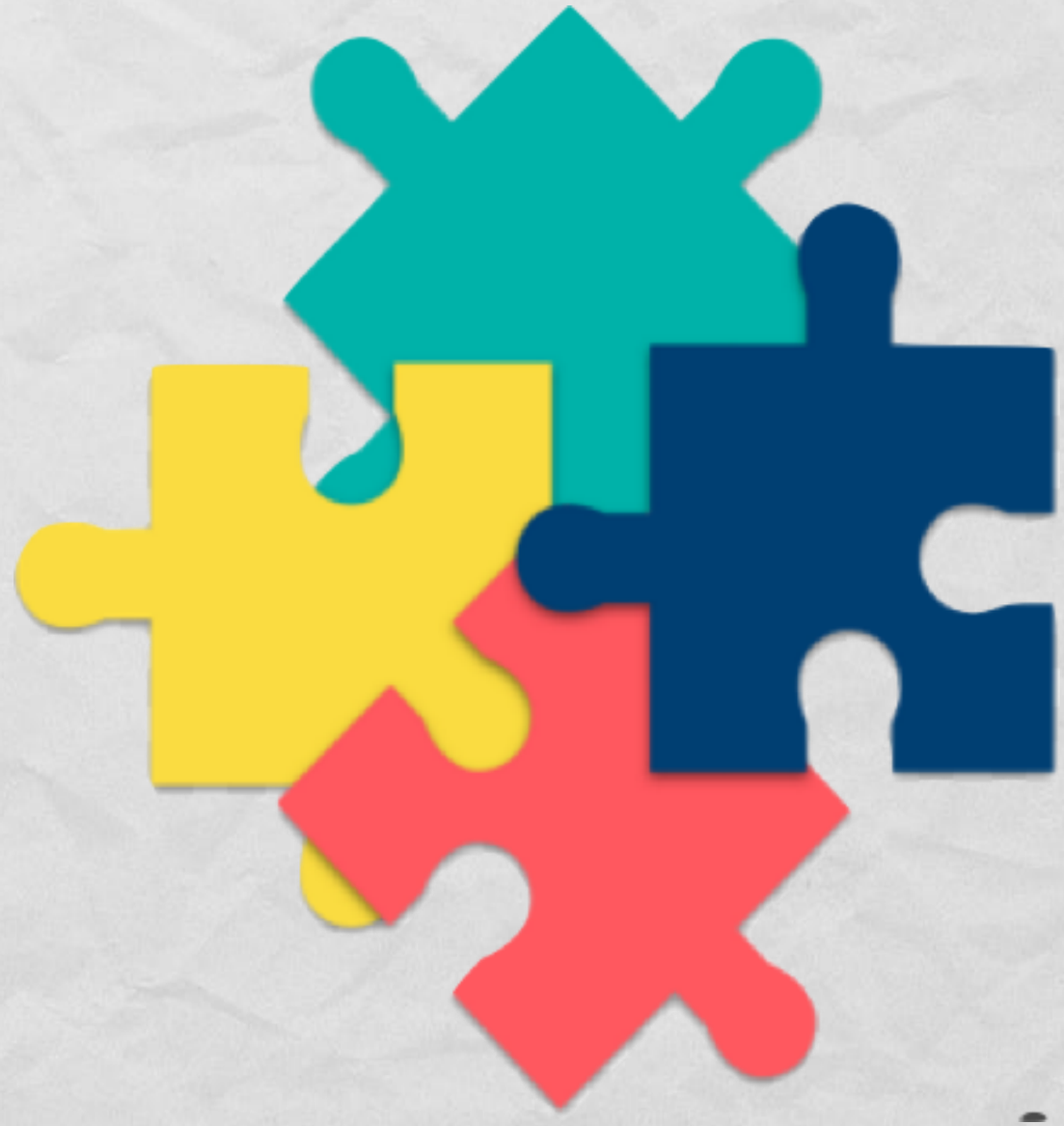
Glaser/Kuppermann et al, NEJM, 2011

Dehydration

CE pre-treatment

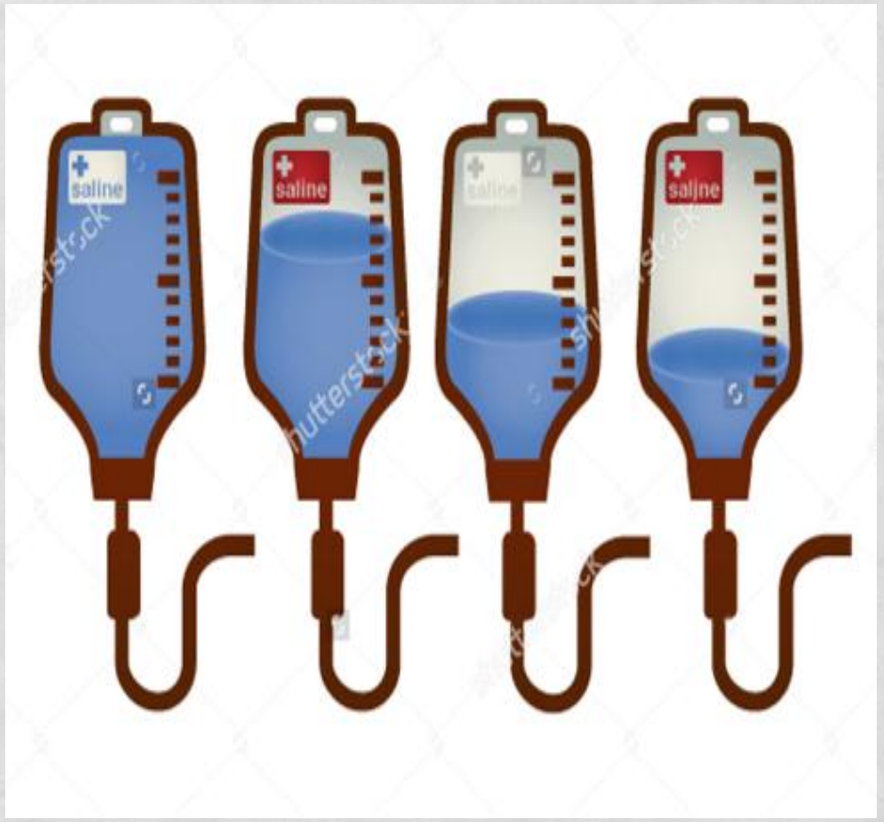
Symptomatic CE with normal CT

MRI spectroscopy



So what IVF Rate is the Best to choose?


NO
EVIDENCE


saline
saline
saline
saline

PECARN Fluid study

- Prospective RCT
- 4 arms of fluid

- 2 boluses 10ml/kg each
- 10% assumed deficit
- Replacement: 50% over 12 hours and the other 50% over 24 hours

0.45% Saline

0.9% Saline

- 1 bolus 10ml/kg
- 5% assumed deficit
- Replacement: evenly over 48 hours

0.45% Saline

0.9% Saline

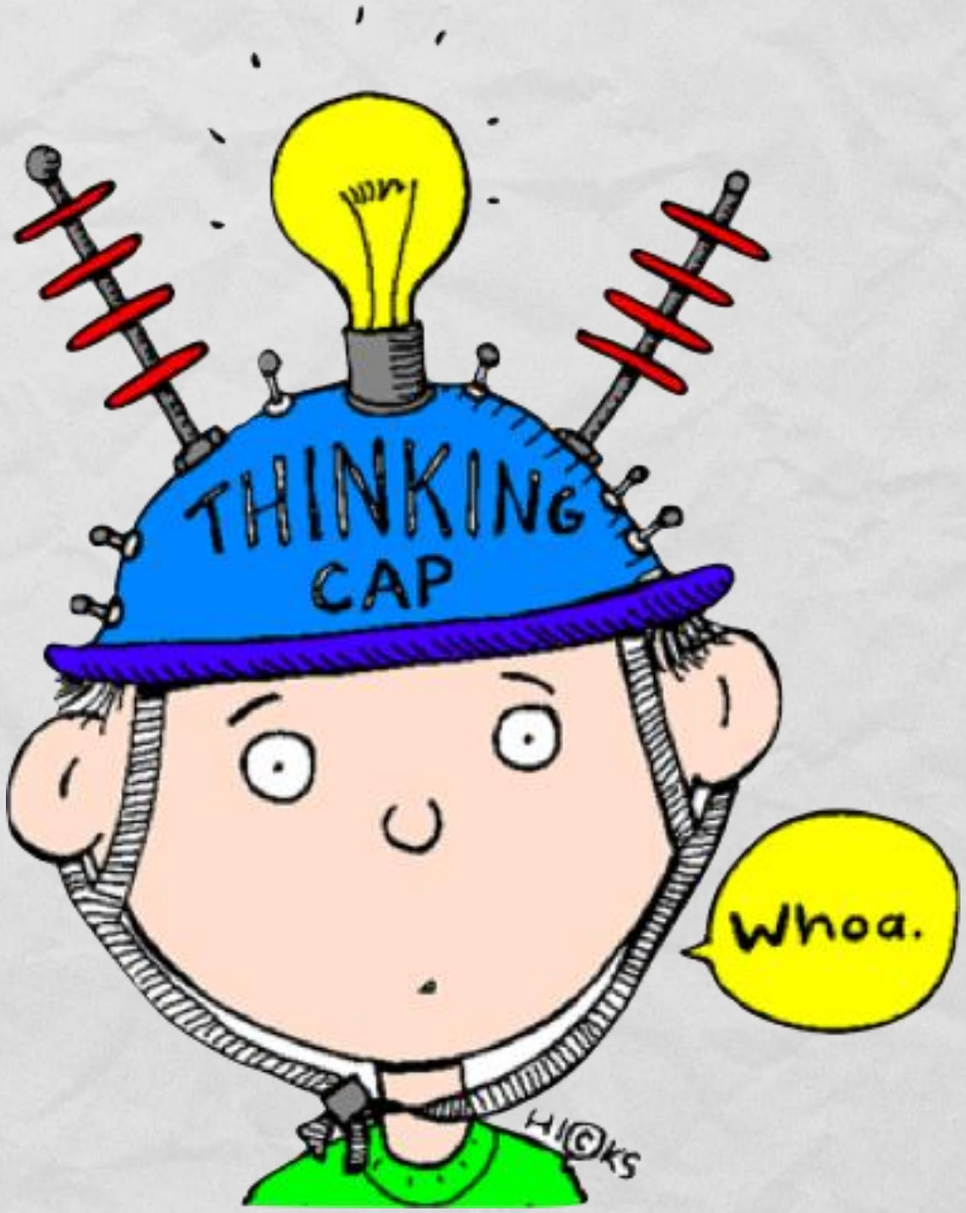
Take Home Message

- There is NO GOLD STANDARD fluid management YET
- Osmotic shift is not the only explanation for CE
- CE can be subtle, watch for it
- Wait for PECARN fluid results

Teşekkürler

شكراً

Thanks



why not bicarb

- Theoretical decrease in tissue perfusion due to
- reversal of the Bohr effect
- Increased risk of hypokalemia
- Does not hasten resolution of acidosis (other than very short term)
- May result in increased hepatic ketone production
- May result in CNS acidosis
- Increased risk of cerebral edema

DKA Complication

- Cerebral Edema
- *<u>But there are other serious complications:</u>*
  - CNS infarction/ hemorrhage including venous *<u>sinus thrombosis</u>*
  - Arrhythmias/cardiac arrest - 2ry to electrolyte abnormalities or possibly long QTc

Complication cont’

- Venous thrombosis 20 hypercoagulable state
- DVT in up to 50% of children with DKA and femoral lines
- Pulmonary edema / ARDS
- Acute renal failure (ATN)
- Bowel ischemia - necrosis, stricture formation

DKA Risk

- This risk increases with poor control

REWERS M, et al. Predictors of acute complications in children with type 1 diabetes. Jama 2002 May 15: 287(19): 2511–8

Corrected sodium = measured Na + 2([plasma glucose −5.6]/5.6) (mmol/L)

- At present, the impact of fluid resuscitation protocols on DKA-related brain injury in children remains unknown.
- No treatment strategy can be definitively recommended as being superior to another based on evidence

PECARN fluid study 2013