

Case conference

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10.1.2013

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Case 1

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Arrival (11:56)

- 11 y/o girl
- T/P/R: 37.6°C/103/22 BP: 89/56
SpO₂: 100% E4V5M6 24kg
- Triage: 3
- Chief complaint: 腹痛

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Present illness

- Decreased activity and poor intake for a week
- Headache and vomiting 10 days ago
- Abdominal pain and vomiting*1 today
- Acid regurgitation(+)
- No fever, no diarrhea

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Physical examination

- Appearance: ill-looking, dehydrated
- Head and neck: dry mucosa
- Chest: RHB, clear breathing sound
- Abdomen: soft, no tenderness
- Extremities: cool limbs, capillary refilling time>2sec

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Impression? Next step?

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Impression

- Severe dehydration, cause to be determined

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12:10

- N/S 500mL challenge
- F/S
- VBG6
- CBC, BCS
- ECG

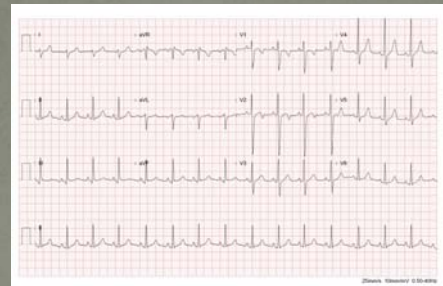
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Immediate data

F/S	high		
VBG6			
pH	7.083	Na	125
pCO ₂	33.7	K	5.4
pO ₂	29	Hct	51%
HCO ₃	10.1		
SaO ₂	36%		

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ECG



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12:35

- On monitor
- Ketone, osm
- Consult pediatricist

- Admitted to PICU at 12:50

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Lab data

WBC (SEG)	Hb	Plt	U/A	
14200 (82%)	15.1	253k	Negative	
BUN	Crea	AST	Osm	Ketone
21	1.21	16	338	1.9

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PICU orders

- On critical
- NPO
- Record I/O Q4H, BW QD
- Dextrosugar Q1H
sugar, ABG Q2H
NA, K, BUN Q6H
- Urine ketone
- Half saline 47mL/hr
insulin pump 50U in 500mL N/S run 23 mL/hr

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PICU course

	Dex	BUN	Crea	Na	K	Cl	HCO ₃	AG	Osm	pH
1hr	487	19	0.91	132	4.1	101	6.6	28.5		7.281
6hr	285	15		131	4.4	107	15.1	13.3	293	7.309
11hr	228	14		132	3.9		20.3		289	7.326
14hr	219	14		132	3.8		21.0		287	7.369

Transfer to ward on day 2

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Lab data

- HbA_{1c} 15%
- TSH 0.5337
Free T₄ 0.65

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Case 2

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Arrival (19:14)

- A 23 y/o man
- T/P/R: 36.5°C/100/18 BP: 119/69
SpO₂: 99% E4V5M6
- Triage: 3
- Chief complaint: 頭痛 嘔吐

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Present illness

- Persistent vertigo for 3 days with mild headache
- Vomiting 2 days ago
- Mild shortness of breath
- No diarrhea, no abdominal pain

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Personal history

- Past history: DM
- Allergy: NKDA

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Physical examination

- Head and neck: pink conjunctiva, supple neck
- Chest: RHB, clear breathing sound
- Abdomen: soft, no tenderness
- Extremities: freely movable
- NE: no gait disturbance, full EOM

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19:28

- F/S
- VBG6
- N/S run 100ml/hr
- ECG
- HB, WBC/DC
- BCS
- Cl, Osm, ketone

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Immediate data

F/S	380		
VBG6			
pH	7.251	Na	131
pCO ₂	31	K	4.2
pO ₂	53	Hct	50%
HCO ₃	13.6		
SaO ₂	82%		

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ECG

23

19:50

- RI 8U SC
- N/S 1000mL challenge
- F/S Q1H
- B/C *1

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Lab data

Hb	WBC(N/L)	AST	Crea
16.3	9900(60/30)	12	1.11
Ketone	Osm	BUN	Cl
4.2	304	21	93
Anion gap	$131 + 4.2 - 13.6 - 93 = 28.6$		

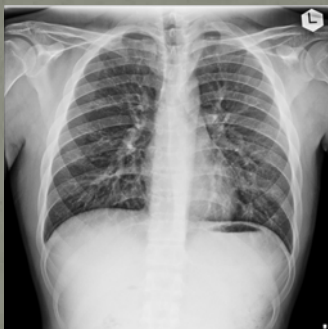
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01:30

- F/S Q2H
- VBG6 + Cl Q6H
- U/A
- CxR
- IV: (N/S 500mL + KCl 10mEq) run 150mL/hr
- To EC

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CxR



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ER course

Time	F/S	RI	VBG	Na	K	Cl	AG
19:30	380	8U SC					
20:30	308						
21:30	263						
23:30	298		pH 7.247 pCO2 32.2 pO2 63 HCO3 14 SaO2 88%	135	4.5	103	19.7
01:30	279	6U SC					
03:00	275						
05:00	224						
07:00	280	6U SC	pH 7.295 pCO2 34.5 pO2 64 HCO3 16.8 SaO2 90%	136	4.3	104	19.5
09:00	226						
11:00	215						

N/S 1000mL challenge (at 23:30 and 01:30)
 IV: D5saline+ RI 4U+ KCl 10mEq, run 120mL/hr (at 05:00)

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ER course

Time	F/S	RI	VBG	Na	K	Cl	AG
13:00	339	10U SC					
15:00	217		pH 7.31 pCO2 40.2 pO2 50 HCO3 20.2 SaO2 81%	137	3.9	104	16.7
17:00	275						
19:00	298	10U SC					
21:00	317	8U SC					
1:00	279	6U SC					
5:00	272	8U SC					
9:00	164						

Discharge (at 9:00)

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Diabetic ketoacidosis

Discussion

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Predisposing factors

DKA
Inadequate insulin treatment or noncompliance
New onset diabetes (20 to 25 percent)
Acute illness
Infection (30 to 40 percent)
Cerebral vascular accident
Myocardial infarction
Acute pancreatitis
Drugs
Clozapine or olanzapine
Cocaine
Lithium
Terbutaline

UpToDate

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Treatment

- Correct the volume deficit
- Correct acid-base imbalance
- Correct electrolyte abnormalities

Tintinalli's Emergency Medicine, 7th edition

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Hypovolemia

- The average fluid loss is 3-6L in DKA
- Correct the estimated deficit within the first 24 hours
- Half saline/normal saline infused at 4 to 14 mL/kg per hour is appropriate

Hyperglycemic crises in adult patients with diabetes. Diabetes Care. 2009;32(7):1335. 33

Ketoacidosis

- IV insulin
 - 0.1U/kg bolus + 0.1U/kg/hr iv drip
 - 0.14/kg/hr iv drip
- BS < 200mg/dL, iv saline → dextrose in saline

Is a priming dose of insulin necessary in a low-dose insulin protocol for the treatment of diabetic ketoacidosis? Diabetes Care. 2008;31(11):2081. 34

Discontinuing the insulin infusion

- The insulin infusion should continue at 0.05 to 0.1 units/kg per hour until:
 - Normal anion gap
 - Venous pH > 7.30 or serum HCO₃ > 15 meq/L
 - Plasma glucose < 200 mg/dL
 - Tolerating oral intake
- The first SC injection should be given at an appropriate interval to allow for absorption prior to stopping insulin infusion

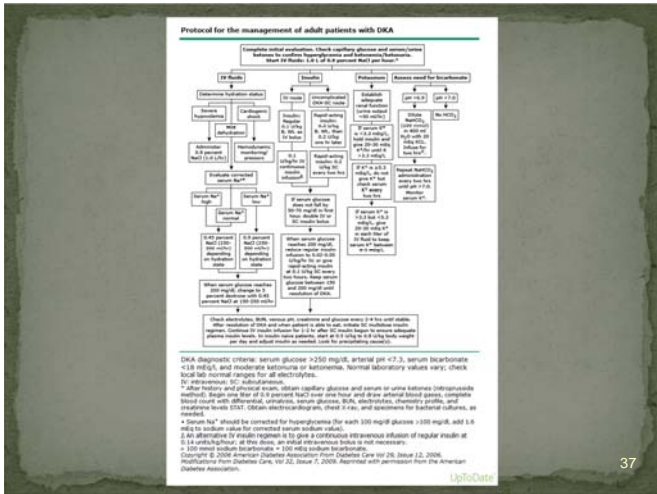
Diabetic ketoacidosis in infants, children, and adolescents: A consensus statement from the American Diabetes Association. Diabetes Care. 2006;29(5):1150. 35

Hypokalemia

- Normokalemic: potassium replacement should be given with the start of insulin therapy
- Hypokalemic: potassium replacement should be started **immediately** (40 meq/L). Monitored hourly. Delay insulin until the serum potassium is in the normal range
- Hyperkalemic: potassium replacement should be initiated when the serum potassium falls to normal

Tintinalli's Emergency Medicine, 7th edition

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Cerebral edema: the complication of DKA in children

Discussion

Cerebral edema and DKA

- Cerebral edema occurs in 0.3 to 1 percent of children with DKA and has a high mortality rate of 21 to 24 percent
- Children who are younger, newly diagnosed with diabetes, or who present with severe acidosis or dehydration are at the greatest risk

Diabetic ketoacidosis in infants, children, and adolescents: A consensus statement from the American Diabetes Association. *Diabetes Care*. 2006;29(5):1150.

Beside evaluation of neurological state of children with diabetic ketoacidosis (DKA)

Major criteria
Altered mentation/fluctuating level of consciousness
Sustained heart rate deceleration (decline of more than 20 beats per minute) not attributable to improved intravascular volume or sleep state
Age-inappropriate incontinence
Minor criteria
Vomiting
Headache
Lethargy or being not easily aroused from sleep
Diastolic blood pressure >90 mmHg
Age <5 years
Diagnostic criteria
Abnormal motor or verbal response to pain
Decorticate or decerebrate posture
Cranial nerve palsy (especially III, IV, and VI)
Abnormal neurogenic respiratory pattern (eg, grunting, tachypnea, Cheyne-Stokes respiration, apneusis)

Signs that occur before treatment should not be considered in the diagnosis of the cerebral edema. Cerebral edema is diagnosed if any of the diagnostic criteria is present. Cerebral edema is also likely if two major criteria OR one major and two minor criteria are present.

mmHg: millimeters of mercury.

Modified with permission from: Muir AB, Quisling RG, Yang MC, Rosenbloom AL. Cerebral edema in childhood diabetic ketoacidosis: natural history, radiographic findings, and early identification. *Diabetes Care* 2004; 27:1541. Copyright ©2004 The American Diabetes Association.

Treatment

- Reduce hydration rate
- Mannitol 0.25-1.0 g/kg IV over 20 minutes. It may be repeated in 2 hrs, if no initial response
- 3% saline (5-10 mL/kg over 30 minutes) has been used as an alternative hypertonic agent
- Intubation and mechanical ventilation may be required
- Hyperventilation should be avoided

ESPE/LWPES consensus statement on diabetic ketoacidosis in children and adolescents. *Arch Dis Child*. 2004;89(2):188.

Outcome

- The mortality rate among children with DKA who develop cerebral edema is approximately 20 to 25 percent
- Among survivors, approximately 15 to 35 percent have permanent sequelae
- Risk factor: elevated BUN, pCO₂<22mmHg, GCS<7

The risk and outcome of cerebral oedema developing during diabetic ketoacidosis. *Arch Dis Child*. 2001;85(1):16.

Type 1 DM and hypothyroidism

Discussion

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Autoimmune hypothyroidism

- Up to 20 percent of patients with type 1 DM have positive anti-thyroid antibodies
- 2 to 5 percent of patients with type 1 diabetes develop autoimmune hypothyroidism

Thyroid autoimmunity in children and adolescents with type 1 diabetes: a multicenter survey. *Diabetes Care*. 2002;25(8):1346.
Polyendocrinopathy in children, adolescents, and young adults with type 1 diabetes: a multicenter analysis of 28,671 patients from the German/Austrian DPV-Wiss database. *Diabetes Care*. 2010 Sep;33(9):2010-2. Epub 2010 Jun 14.

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Screening for hypothyroidism

- Children with beta cell autoantibodies appear to have a higher risk of developing anti-thyroid antibodies
- Because of the high prevalence of thyroiditis and its potential clinical impact, all children with type 1 diabetes should be screened regularly for thyroid disease by measuring TSH

Standards of medical care in diabetes--2011. *Diabetes Care*. 2011;34 Suppl 1:S11.

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Timing of screening

- In general, TSH should be tested several weeks after the diagnosis of type 1 DM, when metabolic control has been established
- At least 20 percent of patients will have transient abnormalities of thyroid function when type 1 DM is first diagnosed, which resolve as the diabetes is treated

Thyroid function at diagnosis of type 1 diabetes. *Arch Dis Child*. 2011;96(8):777.
Thyroid hormone abnormalities at diagnosis of insulin-dependent diabetes mellitus in children. *J Pediatr*. 1984;105(2):218.

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Thanks for your attention!!

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