Clinical update no. 516
27 June 2018

Guideline No: 2015-9075 v2
Guideline: Diabetic Ketoacidosis (DKA)

The Sydney children's Hospitals Network

DIABETIC KETOACIDOSIS (DKA)

PRACTICE GUIDELINE *

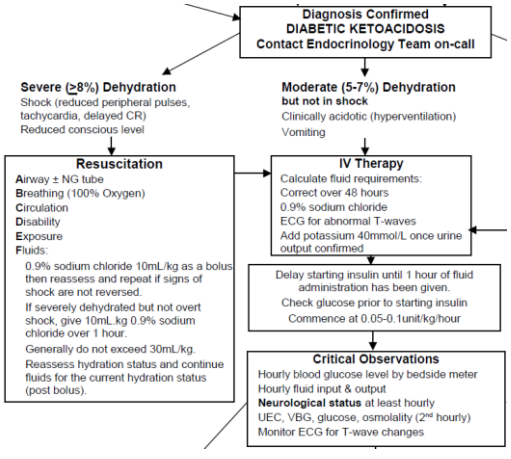
Date of Publishing: 5 June 2018

www.schn.health.nsw.gov.au/_policies/pdf/2015-9075.pdf

Diagnosis of DKA

Diagnosis
Hyperglycaemia: blood glucose greater than 11mmol/L
Venous pH less than 7.3 or bicarbonate less than 15mmol/L
Presence of ketonaemia or ketonuria

Current treatment protocols for DKA in children require initial IV rehydration prior to starting insulin infusion, with K replacement (add 40 mmol KCL to 1 litre). Read the full document for detail. If moderate dehydration give the initial fluid requirement for 1 hour before starting insulin. Use the table to calculate an hourly rate to replace fluids over 48 hours. Do not give more rapidly unless clinically in shock; giving 10 ml/kg of 0.9% saline over 1 hour or as a bolus depending on severity. Giving a repeat bolus of 10 ml/kg is not often required, and more than 2 boluses are rarely required.



Blood glucose ≤ 15mmol/L or falling >5mmol/L/hr after the initial fall associated with the first 1-2 hours of fluid therapy

IV Therapy

Change to IV fluids containing 5% glucose (either 0.9% or 0.45% sodium chloride or Plasma-Lyte 148 depending on corrected sodium and rate of change of this).
Maintain BGL >5mmol/L

Neurological deterioration is the most serious complication, requiring urgent administration of mannitol or 3% saline.

Table 1: IV fluid rates (mL/hr) to give maintenance fluids plus replacement of the deficit over 48 hrs

Weight (kg)	Dehydration			
	3%	5%	7%	10%
5	24	26	28	31
7	34	36	39	44
8	38	42	45	50
10	48	52	56	63
12	53	58	63	71
14	59	65	70	79
16	64	71	78	88
18	70	77	85	96
20	75	83	92	104
22	78	87	96	110
24	81	91	101	116
26	84	95	105	122
28	87	98	110	128
30	90	102	115	133

Neurological
WARNING SIGNS: headache, slowing heart rate, irritability, decreased conscious level, incontinence, specific neurological signs

Exclude Hypoglycaemia

Is it Cerebral Oedema?

Management

Manage ABCDEF
Urgent consultation with ICU regarding management & in anticipation transfer to ICU
Consider Mannitol 0.5 – 1.0 g/kg or 3% sodium chloride [3-5 mL/kg]
Consider CT brain - **only** after patient stabilised

It is speculated but not clear whether the rate and type of fluid administration may increase the risk of cerebral oedema.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Clinical Trial of Fluid Infusion Rates for Pediatric Diabetic Ketoacidosis

for the PECARN DKA FLUID Study Group*

N ENGL J MED 378;24 NEJM.ORG JUNE 14, 2018

BACKGROUND
Diabetic ketoacidosis in children may cause brain injuries ranging from mild to severe. Whether intravenous fluids contribute to these injuries has been debated for decades.

This study evaluated 1389 episodes of DKA in children to address the unresolved question of whether fluid type and rate of administration contributed to brain injury.

CONCLUSIONS

Neither the rate of administration nor the sodium chloride content of intravenous fluids significantly influenced neurologic outcomes in children with diabetic ketoacidosis.

QUICK TAKE

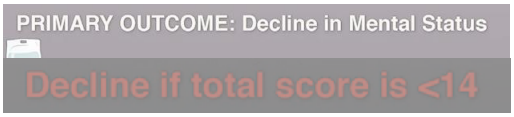
Does Infusion Rate Affect Neurologic Outcomes in Pediatric DKA?

https://www-nejm-org.virtual.anu.edu.au/do/10.1056/NEJMdo005305/full/ A 2 minute video explains all.

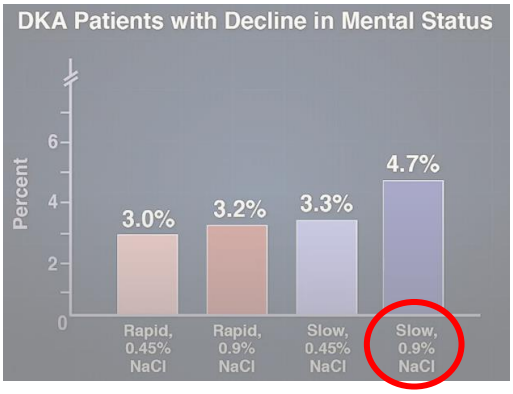
The rapid infusion arm gave 2 boluses of 10 ml/kg 0.9% saline followed by an assumed 10% deficit replaced by giving half over 12hr and the remainder over a further 24hr

The slow infusion arm gave a single 10 ml/kg bolus of 0.9% saline followed by an assumed 5% deficit replaced over 48hr.

Both arms were also randomised to receiving either 0.9% saline or 0.45% saline.



The primary outcome was a decline in GCS to <14. There were other measures of neurological status on follow up.



There was no significant difference in adverse neurological events in any group. Either mannitol or 3% saline or both were given in 12 patients, aged from 3 to 16 years. There was 1 death.

Table 3. Mental Status Changes during Treatment for Diabetic Ketoacidosis.*

Outcome	Fast Administration of 0.45% Sodium Chloride Solution	Fast Administration of 0.9% Sodium Chloride Solution	Slow Administration of 0.45% Sodium Chloride Solution	Slow Administration of 0.9% Sodium Chloride Solution
Primary outcome				
No. of episodes†	337	345	338	341
Confirmed decline in Glasgow Coma Scale score to <14 — no. (%)‡	10 (3.0)	11 (3.2)	11 (3.3)	16 (4.7)

Fast vs. Slow Administration		0.45% vs. 0.9% Sodium Chloride Solution	
Relative Risk (95% CI)	P Value	Relative Risk (95% CI)	P Value
0.76 (0.44–1.33)	0.34	0.80 (0.46–1.40)	0.43

There was a non significant trend to more adverse outcomes in the slow administration/ 0.9% saline group, and least with rapid admistration of 0.45% saline.

Nonneurologic Adverse Events

Hyperchloremic acidosis was more common with 0.9% saline than 0.45% saline.

DISCUSSION

There was no causal association of rapid fluid administration and brain injury in DKA. Cerebral oedema has been noted in some patients on presentation and before fluid resuscitation. It may be the marker of the underlying processes and is not attributable to type of fluid or rate of adminsitration.

Fluid Composition, Infusion Rate, and Brain Injury in Diabetic Ketoacidosis

The mechanism for cerebral oedema is likely related to ischaemia and reperfusion injury rather than osmosis. The trial showed a trend to better outcomes with faster rates of fluid adminsitration. Adverse outcomes were predominantly seen with more severe acidosis and lower Pco_2. The low rate of adverse outcomes and 1 death highlights the benefit of management in specialised settings.

These updates are a review of current literature at the time of writing and are the views of Dr Brendon Smith, FACEM. Over time they will become outdated. They do not replace local treatment protocols and policy. Treating doctors are individually responsible for following standard of care.