

Acute Complications of Diabetes Mellitus

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Complications of diabetes

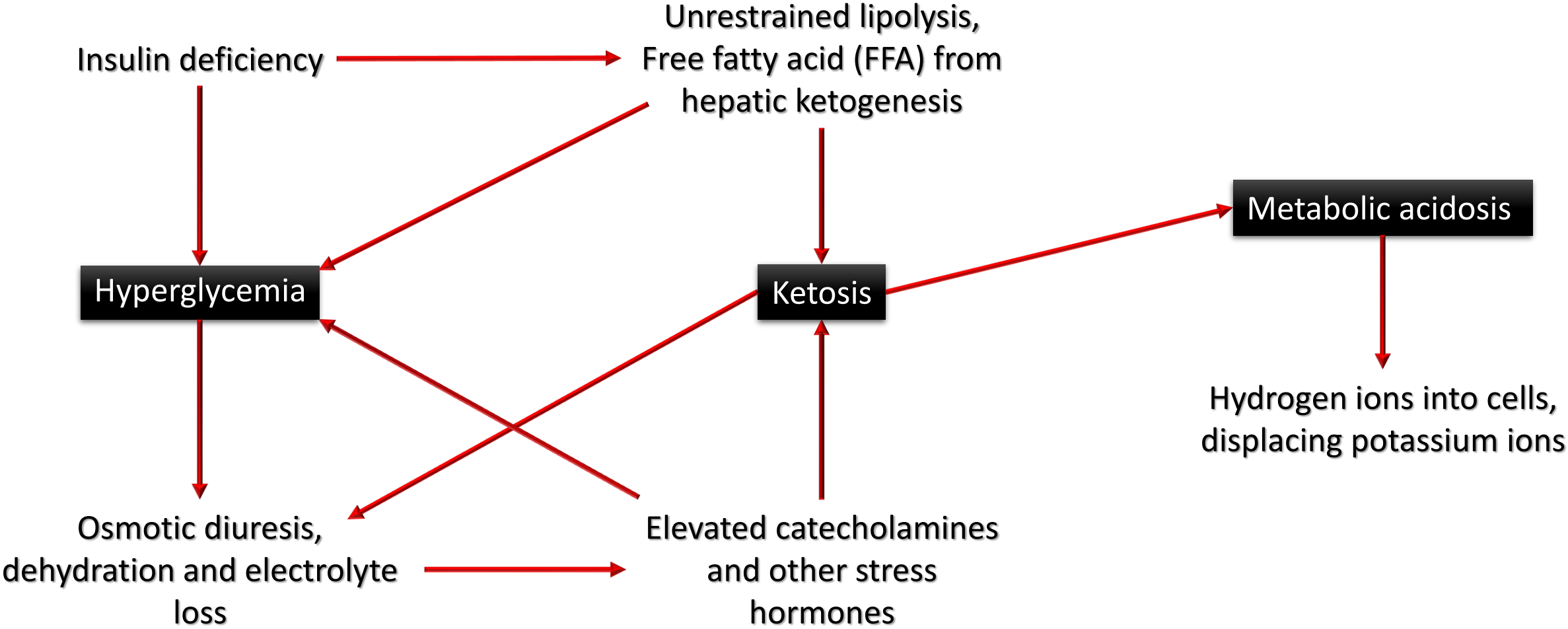
Acute

- Diabetic ketoacidosis (DKA)
- Non-ketotic hyperosmolar diabetic coma, Hyperglycemic hyperosmolar state (HHS)
- Hypoglycemia

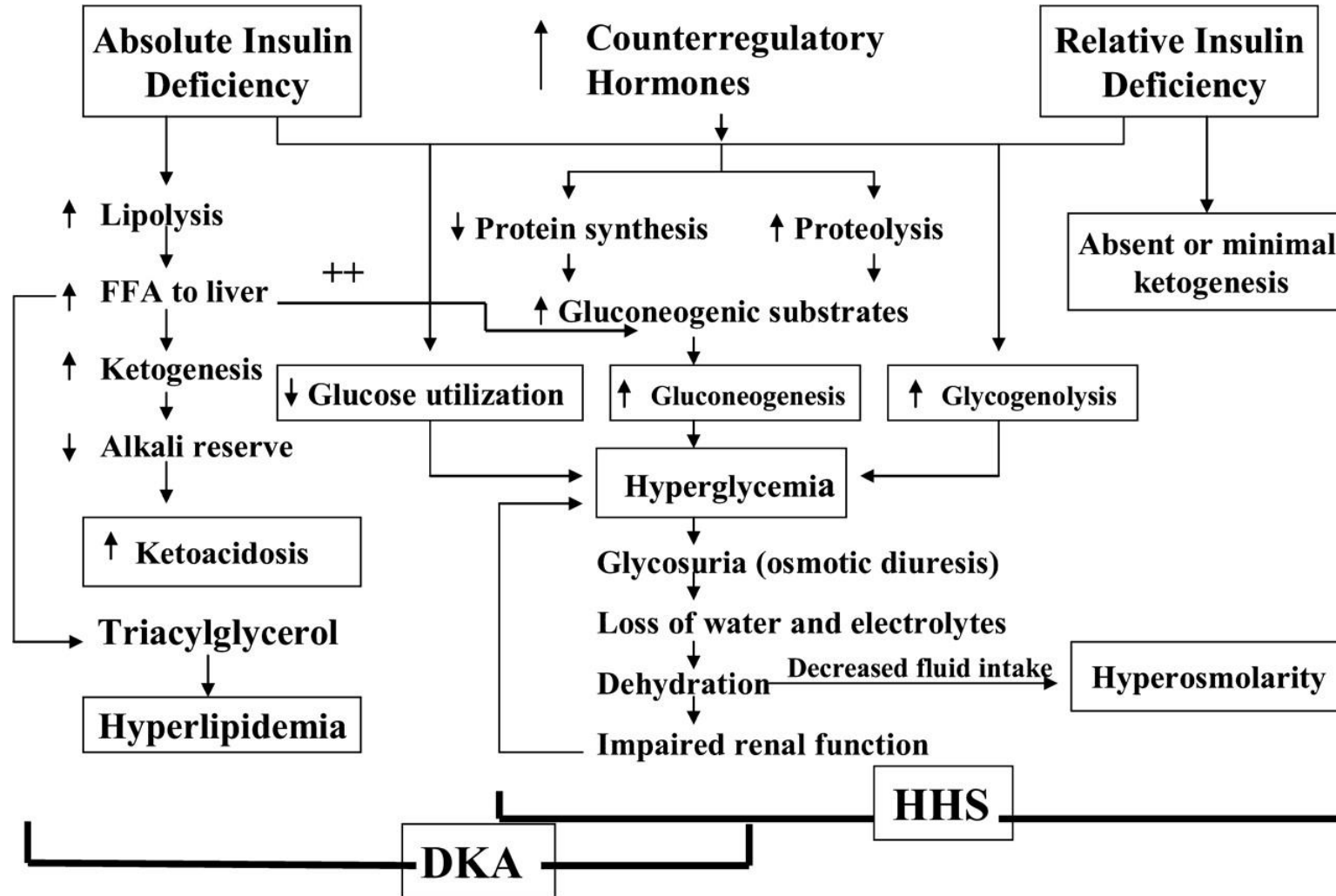
Chronic

- Macrovascular (ASCVDs)
- Microvascular:
 - Retinopathy
 - Neuropathy
 - Nephropathy

Diabetic ketoacidosis (DKA)

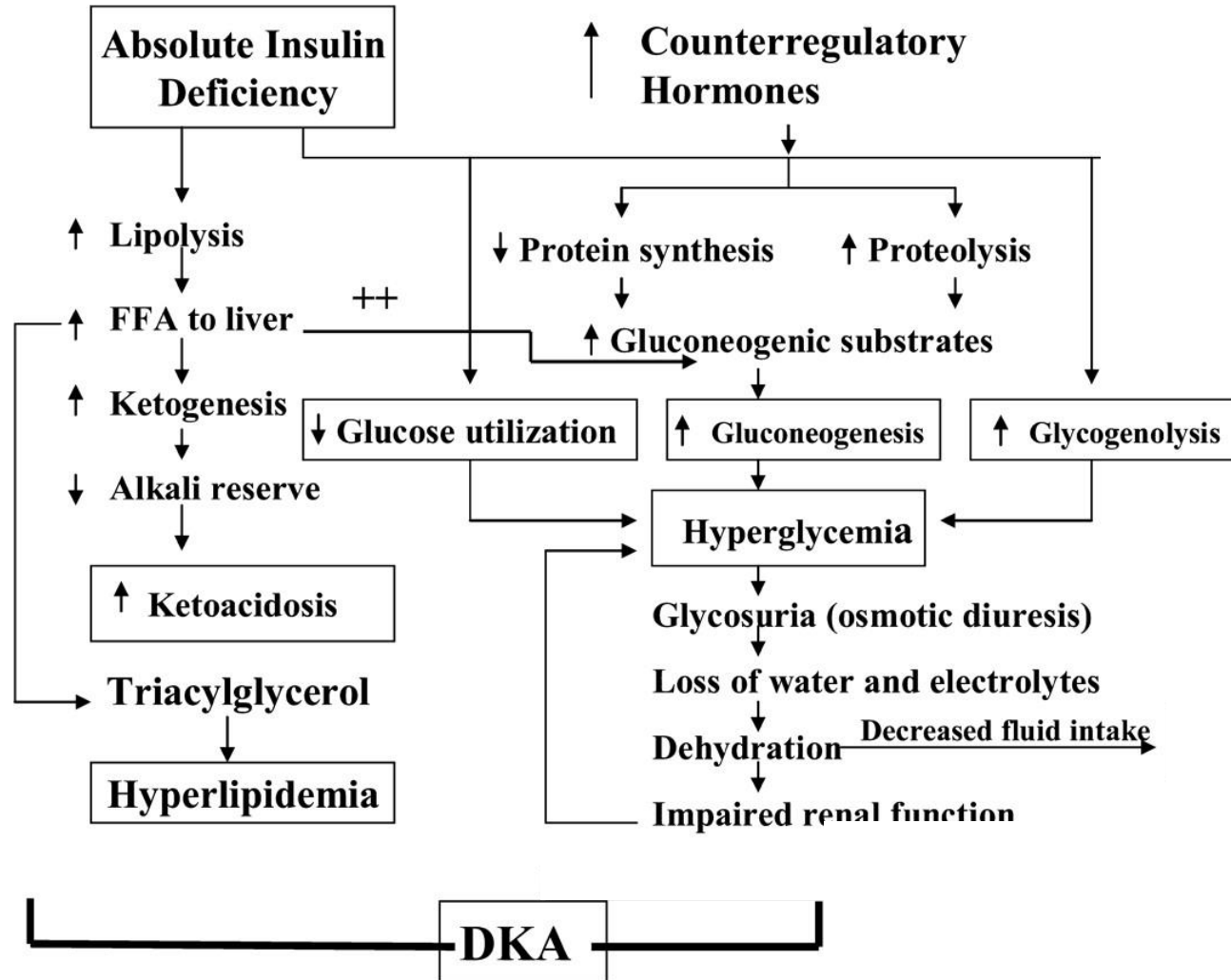


Pathogenesis of DKA and HHS: stress, infection, or insufficient insulin.



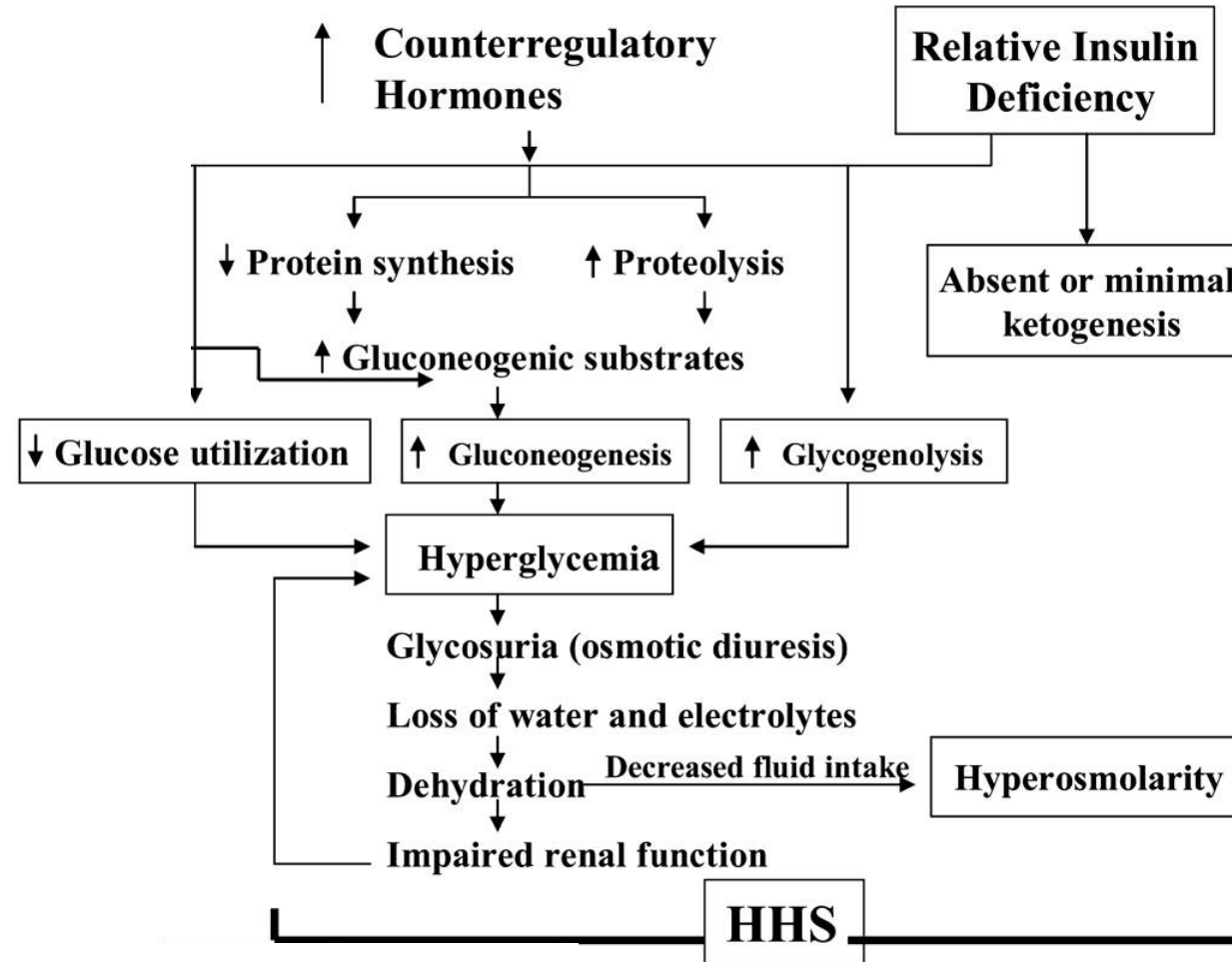
Abbas E. Kitabchi et al. Dia Care 2009;32:1335-1343

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Pathogenesis of DKA and HHS: stress, infection, or insufficient insulin.



Average loss of fluid and electrolytes in adult diabetic ketoacidosis of moderate severity

Water: 6 L

Sodium: 500 mmol

Chloride: 400 mmol

Potassium: 350 mmol

Ketone bodies

- Are three water-soluble compounds that are produced as by-products when fatty acids are broken down for energy in the liver and kidney.

Acetoacetate

3-beta-
hydroxybutyrate

Acetone

Causes of Diabetic Ketoacidosis

- Omission or reduced daily insulin injections (the most common)
- Infection
- Pregnancy
- Hyperthyroidism
- Medications: steroids, thiazides, antipsychotics, sympathomimetics
- Cerebrovascular accident or myocardial infarction
- GI hemorrhage
- Pulmonary embolism
- Pancreatitis
- Major trauma
- Surgery

Clinical features of diabetic ketoacidosis

Hyperglycemia

- Thirst, polyuria, polydipsia, nocturia ,vomiting and abdominal pain

Dehydration

- Weak and rapid pulse, dry tongue and skin, hypotension, and increased capillary refill time.

Acidosis

- Shallow, rapid breathing or air hunger (Kussmaul or sighing respiration), abdominal tenderness, and disturbance of consciousness.
- Untreated will end with coma

The biochemical criteria for DKA include the following triad

Hyperglycemia ≥ 250 mg/dL

Venous pH < 7.3 and/or bicarbonate < 15 mmol/L

Ketonemia and ketonuria

Effective serum osmolality < 320 mOsm/kg

Investigations in DKA

Venous blood

- Urea and electrolytes, glucose, bicarbonate

Arterial blood gases assess the severity of the acidosis

- The severity of ketoacidosis can be assessed rapidly by measuring the venous plasma bicarbonate; less than 12 mmol/L indicates severe acidosis. The hydrogen ion concentration gives a more precise measure, but requires arterial blood

Urinalysis for ketones

- A meter is available to quantify ketones in plasma, and a test strip can be used as a semi-quantitative guide to the plasma concentration of acetoacetate and acetone

Investigations in DKA

ECG

- Exclude ACS, clue about electrolytes changes

Infection screen

- Full blood count, blood and urine culture, C-reactive protein, chest X-ray
- Although leucocytosis invariably occurs, this represents a stress response and does not necessarily indicate infection.

Complications of diabetic ketoacidosis

- Cerebral edema
 - May be caused by a very rapid reduction of blood glucose, the use of hypotonic fluids and/or bicarbonate
 - High mortality
 - Treat with mannitol, oxygen
- ARDS
- Thromboembolism
- Acute circulatory failure
- Mortality with treatment <1%

Non-ketotic hyperosmolar diabetic coma Hyperglycemic hyperosmolar state (HHS)

Plasma glucose concentration >33.3 mmol/L (600 mg/dL)

Arterial pH >7.30 or Serum bicarbonate >15 mmol/L

Small ketonuria, absent to mild ketonemia

Effective serum osmolality >320 mOsm/kg

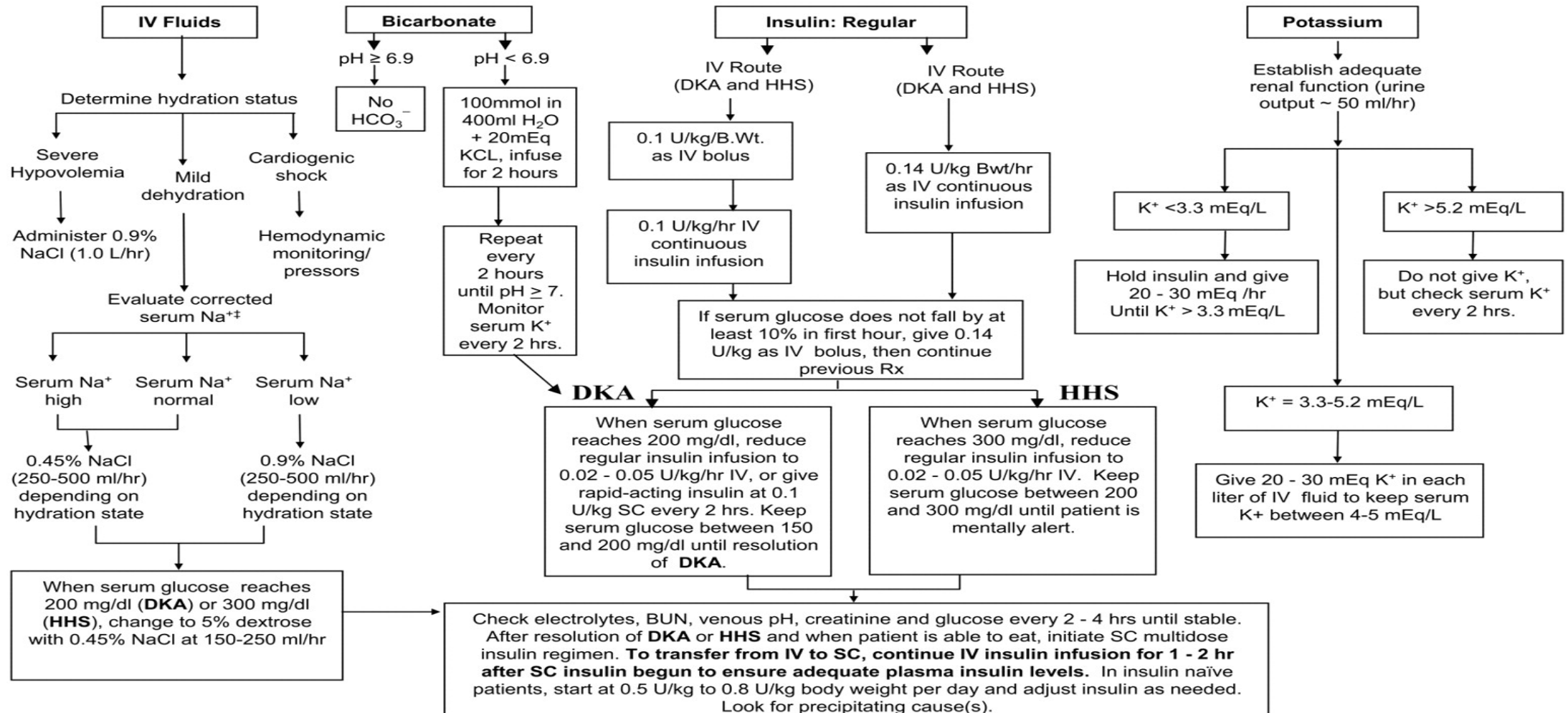
Stupor or coma

Comparison between Diabetic Ketoacidosis and Non-ketotic hyperosmolar diabetic state (HHS)

| | DKA | HHS |
|----------------------------|-----------------------|----------------------|
| Age | Younger | Elderly |
| Type of diabetes | Type 1 | Type 2 |
| Duration of symptoms | Short (hours to days) | Long (days to weeks) |
| Dehydration | Mild to moderate | Severe |
| Venous pH | <7.3 | ≥7.3 |
| Serum bicarbonate | <15 mmol/L | ≥15 mmol/L |
| Effective serum osmolality | Variable | >320 mOsm/kg |
| Associated illness | Not common | Very common CVA,MI |
| Urine ketone | ++++ | +/- |
| Mortality | <1 | 40% |

Protocol for management of adult patients with DKA or HHS. DKA diagnostic criteria: blood glucose 250 mg/dl, arterial pH 7.3, bicarbonate 15 mEq/l, and moderate ketonuria or ketonemia.

Complete initial evaluation. Check capillary glucose and serum/urine ketones to confirm hyperglycemia and ketonemia/ketonuria. Obtain blood for metabolic profile. Start IV fluids: 1.0 L of 0.9% NaCl per hour.†



Hypoglycemia

- It's the most common acute complication.
- Reduced plasma glucose <70 mg/dL with symptoms and improvement of symptoms if plasma glucose increased.
- Insulin , sulphonylureas.

Counter-regulatory hormone responses to Hypoglycemia

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3

4

5

6

↑ Cortisol and growth hormone

Symptoms

↑ Epinephrine

↓ Insulin

↓ Cognition

↑ Glucagon

Counter-regulatory hormone responses to Hypoglycemia

| Response | Glycemic threshold (mg/dL) | Role in correction of hypoglycemia |
|-------------------------------|----------------------------|------------------------------------|
| ↓ Insulin | 80 | First response |
| ↑ Glucagon | 70 | Second response, most powerful |
| ↑ Epinephrine | | |
| ↑ Cortisol and growth hormone | 70 | Not critical |
| Symptoms | | |
| ↓ Cognition | 50 | Compromise behavioral response |

Attenuated in DM

Attenuated with autonomic neuropathy and repeated hypoglycemia

Attenuated with autonomic neuropathy and repeated hypoglycemia

Causes of hypoglycemia

- Missed, delayed or inadequate meal
- Unexpected or unusual exercise
- Alcohol
- Errors in oral anti-diabetic agent(s) or insulin dose/schedule/administration
- Poorly designed insulin regimen, particularly if predisposing to nocturnal hyperinsulinaemia
- Lipohypertrophy at injection sites causing variable insulin absorption
- **Renal failure**
- Gastroparesis due to autonomic neuropathy
- Malabsorption, e.g. celiac disease
- Unrecognised other endocrine disorder, e.g. Addison's disease
- Factitious (deliberately induced)

Types of hypoglycemia

Nocturnal or Day time

Mild - Moderate

Severe (Need assistant or hospital care), glucose < 53 mg/dL

Confirmed (low glucose confirmed by glucometer or venous blood)

Symptoms of hypoglycemia

I'm sorry about what I said
when I was hypoglycemic

Symptoms of hypoglycemia

Adreno glycopenic

- Shakiness, anxiety, nervousness, palpitations, tachycardia, sweating, feeling of warmth, pallor, coldness, clamminess, dilated pupils (mydriasis), feeling of numbness.

Neuro glycopenic

- Abnormal mentation, nonspecific dysphoria, depression, crying, exaggerated concerns, negativism, irritability, personality change, emotional lability, weakness, apathy, lethargy, daydreaming, sleep, confusion, amnesia, dizziness, delirium, automatic behavior, difficulty speaking, ataxia, incoordination, sometimes mistaken for "drunkenness", focal or general motor deficit, paresthesia, headache, stupor, coma, abnormal breathing, generalized or focal seizures

Non- specific

- Hunger, borborygmus, nausea, vomiting, abdominal discomfort, headache

Diagnosis of hypoglycemia

- Whipple's triad

Symptoms and
signs

Glucose less
than 70
mg/dL

Improvement
after glucose
intake

Complications of hypoglycemia

Brain

- Impaired cognitive function, coma, convulsions, intellectual decline, transient ischemic attack, stroke, brain damage (rare), focal neurological lesions (rare)

Heart

- Cardiac arrhythmias, myocardial ischemia, death

Eye

- Vitreous hemorrhage, Worsening of retinopathy

other

- RTA, hypothermia

Treatment of hypoglycemia

- Mild (self treatment)
 - Oral fast-acting carbohydrate (10-15 g) is taken as glucose drink or tablets or confectionery
 - This should be followed by a snack containing complex carbohydrate

Treatment of hypoglycemia

- Severe (external help is required)
 - **If patient is conscious and able to swallow:**
 - Give oral refined glucose as drink or sweets (=25 g)
or
 - Apply glucose gel or jam or honey to buccal mucosa

Treatment of hypoglycemia

- Severe (external help is required)

. If the patient is semiconscious or unconscious, parenteral treatment is required:

- I.V. 75 ml 20% dextrose (=15 g; give 0.2 g/kg in children) Or
- I.M. glucagon (1 mg; 0.5 mg in children)

Treatment of hypoglycemia

- Patients with hypoglycemia due to drug secretagogues (glibenclamide) or insulin may need to stay in hospital for few day to 1 week to avoid relapse of hypoglycemia especially among elderly with renal impairment, because there is a risk of rebound hypoglycemia.
- Drugs dose adjustment after each hypoglycemic spell is mandatory.

- Next

Chronic complications of diabetes mellitus