МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
Харківський національний медичний університет

MODERN PRACTICE OF INTERNAL MEDICINE WITH EMERGENCY CONDITIONS

Management of patients with coma

Guidelines for students and interns

СУЧАСНА ПРАКТИКА ВНУТРІШНЬОЇ МЕДИЦИНИ З НЕВІДКЛАДНИМИ СТАНАМИ

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для студентів та лікарів-інтернів

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Management of patients with coma

General Outcome

The students should be able to describe main links of pathogenesis, clinical features, diagnostic and treatment patients with hypoglycemic coma, hyperosmolar nonketotic diabetic coma, diabetic ketoacidosis, uremic and hepatic encephalopathy.

The aim of this topic is to provide the student with an opportunity to:

• Provide a basic overview of the pathophysiology, diagnosis, and classification of coma.

• Evaluate guideline-based management strategies for the treatment of coma.

• Develop an individualized pharmacotherapy and monitoring plan for the management of coma, when given specific patient information.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

1. Describe the different types of comas.
2. Describe the main mechanism of etiopathogenesis.
3. Describe the main clinical features.
4. List and describe the group of drugs that are used in the treatment and give specific examples of each.
5. Make a treatment plan of patient.

Specification of the theoretical question for training of "Management of the patients of the different type of comas".

Student must know:

1. What is the definition of coma?
2. What are the main causes?
3. What are the main pathogenetic links?
4. What are the clinical features?
5. What laboratory tests are used in patients?
6. What treatment methods are used in patients?

DEFINITION

Coma (or unconsciousness) is a state in which a patient is totally unaware of both self and external surroundings, and unable to respond meaningfully to external stimuli.

Coma results from gross impairment of both cerebral hemispheres, and/or the ascending reticular activating system.

There are many causes of coma (including Newcastle Brown Ale), and these may be classified as either focal or diffuse brain dysfunction.

Some causes of coma include:

• Head trauma, such as may be sustained in a car accident, sports injury or falling injury;

• Complication of an underlying disease, such as seizure disorder, diabetes or liver or kidney failure;

• Poisoning, usually involving an overdose of drugs that depress the nervous system, such as narcotics, tranquilizers or alcohol;

• Stroke.

Coma rarely lasts more than a month and usually ends sooner. Coma may worsen to become a persistent vegetative state.

A person in a coma will be unconscious and unable to communicate. He or she will not respond to light, sound or pain. The person may stretch his or her arms and legs in unusual ways, but the person will not display purposeful movement. In a deep coma, the areas of the brain that control breathing may be affected, and the person may need to be kept alive by an artificial respirator (a mechanical breathing machine).

A person in a persistent vegetative state will be able to breathe without asistance. He or she will have cycles of being awake and asleep. During the awake cycles, the person may react to physical pain and may move, but the movement will not be purposeful.

The use of terms other than coma and stupor to indicate the degree of impairment of consciousness is beset with difficulties and more important is the use of coma scales (Glasgow Coma Scale), (*table*).

Table

Glasgow Coma Scale (GCS)

<table>
<tr><th>Best eye response (E)</th><th>Best verbal response (V)</th><th>Best motor response (M)</th></tr>
<tr><td>4 Eyes opening spontaneously</td><td>5 Oriented</td><td>6 Obeys commands</td></tr>
<tr><td>3 Eye opening to speech</td><td>4 Confused</td><td>5 Localizes to pain</td></tr>
<tr><td>2 Eye opening in response to pain</td><td>3 Inappropriate words</td><td>4 Withdraws from pain</td></tr>
<tr><td rowspan="3">1 No eye opening</td><td>2 Incomprehensible sounds</td><td>3 Flexion in response to pain</td></tr>
<tr><td rowspan="2">1 None</td><td>2 Extension to pain</td></tr>
<tr><td>1 No motor response</td></tr>
</table>

Diabetic coma is a condition that poses a dangerous threat to individuals with diabetes. Treatment is more effective the earlier it is started but depends on the cause of the coma as this defines which type of diabetic coma a patient has.

The three causes of diabetic coma are severe hypolgycemia or lowering of the blood sugar level, diabetic ketoacidosis which causes high blood glucose levels, and hyperglycaemic hyperosmolar state which also causes raised blood glucose.

Therefore, when a diabetic patient is unconscious, the first action taken is blood sugar testing. If the cause is hypoglycemia, treatment is aimed at raising the blood sugar levels, whereas it is aimed at reducing the blood sugar with either of the other two conditions.

Hypoglycemic coma

Hypoglycemia refers venous plasma glucose concentration is less than 2.8 mmol/L (50 mg/dl), coma caused by hypoglycemia, said hypoglycemic coma. The effect of low blood sugar in the nervous system of the body mainly sympathetic and especially the brain, after sympathetic stimulation by low blood sugar, increased secretion of catecholamines, which can stimulate the secretion and blood glucose levels are elevated glucagon, but also acting on adrenergic receptors causes tachycardia, irritability, pale, sweating and blood pressure and other symptoms of sympathetic activity, glucose is the brain, especially the major source of energy for the brain, but the brain cells to store glucose capacity is very limited, only a few minutes of brain activity to maintain energy requirements, so the main energy source for the brain is glucose, a longer period of severe hypoglycemia can severely damage the brain, brain glucose deprivation can occur early congestion multiple hemorrhagic petechiae then due to brain cell membrane Na^+/K^+ pump damage, Na^+ poured into brain cells, followed by cerebral edema and brain spotty necrosis.

Causes of fasting hypoglycemia include:

- islet B cell tumor (insulinoma); outside islet tumor; exogenous insulin, oral hypoglycemic agents; severe liver disease; alcoholic; pituitary, adrenal insufficiency and so on.
- postprandial hypoglycemia caused common reasons: after gastrectomy (nourish hypoglycemia); alcoholic; type of early diabetes; pituitary, adrenal insufficiency and so on.

Pathophysiology

The effect of low blood sugar in the nervous system of the body mainly sympathetic and especially the brain, after sympathetic stimulation by low blood sugar, increased secretion of catecholamines, which can stimulate the secretion and blood glucose levels are elevated glucagon, but also acting on adrenergic receptors causes tachycardia, irritability, pale, sweating and blood pressure and other symptoms of sympathetic activity, glucose is the brain, especially the major source of energy for the brain, but the brain cells to store glucose capacity is very limited, only a few minutes of brain activity to maintain energy requirements, so the main energy source for the brain is glucose, a longer period of severe hypoglycemia can severely damage the brain, brain glucose deprivation can occur early congestion multiple hemorrhagic petechiae; then due to brain cell membrane Na^+/K^+ pump damage, Na^+ poured into brain cells, followed by cerebral edema and brain spotty necrosis, late occurs neuronal necrosis, disappearance, forming

tissue soften the brain, all parts of the nervous system sensitivity to different hypoglycemia, the most sensitive to the cerebral cortex, hippocampus, cerebellum, caudate nucleus and the globus pallidus, followed by cranial nerve nuclei, thalamus, hypothalamus and brainstem, the lower the sensitivity of the spinal cord, It was found abroad, hypoglycemia on brain damage and brain ischemic injury similar, but not identical, but is often accompanied by severe hypoglycemia on brain tissue oxygen uptake rate has dropped, but the brain tolerance to hypoxia even worse, it is even more severe hypoglycemia on brain damage.

Symptoms

Symptoms of low blood sugar coma weakness, nausea, confusion, forgetfulness, pale manic convulsions shaking sleepiness

Sympathetic performance: This group of symptoms and rapid decline in blood glucose, adrenaline is more obvious when more compensatory response is caused by a low blood sugar, including sweating (about 1/2 of common cold sweat), tremor (about 1/3), blurred vision, hunger, weakness (about 1/4 to 1/3), as well as nervous, pale, palpitations, nausea, vomiting, chills and other extremities.

The central nervous system by inhibiting the expression: This group of symptoms is slow and prolonged decline in blood glucose were more common variety of clinical manifestations, mainly the central nervous system hypoxia, glucose deprivation syndrome group, the more advanced central nervous system by inhibiting the sooner, while the later recovery, mainly To:

– cerebral cortex inhibited; dim consciousness, disorientation and discriminating gradual loss, headache, dizziness, forgetfulness, language barriers, lethargy and even coma fall, sometimes suffer from mental disorders, fear, confusion, hallucinations, mania, etc;

– under central cortex inhibited; confusion, irritability, may have clonic, or naive dance movements, tachycardia, mydriasis, paroxysmal convulsions, positive pyramidal tract signs, etc., can occur in patients epilepsy;

– medulla inhibition; a deep coma, brain tonic to the various reflexes, weak shallow breathing, blood pressure, restlessness, this state of affairs lasted longer, the patient is not easy to recover.

If the brain tissue in a relatively long-term state of severe hypoglycemia can be necrosis and liquefaction, brain tissue can atrophy, patients often have memory loss, mental deterioration, mental or personality disorders, such as performance variation occurs.

Mixed performance: Referring patients both sympathetic performance, but also the central nervous system by inhibiting the performance of this type is more common clinically.

The primary symptoms of the disease:

Such as liver disease, cancer and serious infections, there are manifestations of multiple endocrine neoplasia, such as pituitary tumors and parathyroid disease.

Inspection

Check

Blood sugar: Hypoglycemia is a critical illness, the patient must first be determined quickly and accurately glucose, patients do not have to wait for suspicious biochemical analysis results, treatment should be carried out immediately after the specimens were quickly determined simultaneously with the biochemical detection conditions.

Normal venous plasma glucose concentration after overnight fasting, <3.3 mmol/L (50 mg/dl) is prompted hypoglycemia, since there are individual differences in the diagnostic criteria of low blood sugar should be a range rather than a specific value, the range should be 2.5~3.3 mmol/L (45~60 mg/dl), but lower than 2.5 mmol/L, and by repeated measurements confirmed the presence of hypoglycemia may be clear.

Other tests: Other laboratory tests per patient was not diabetic hypoglycemia are absolutely necessary, with optional.

- glycosylated hemoglobin (GHB): HBAc which is the main product of hemoglobin and glucose combined, nearly two months may reflect average blood glucose levels, HBAc normal 4 to 6 %, in the long-term acceptance of insulin therapy type 1 diabetes, the incidence of hypoglycemia HBAc values were negatively correlated, HBAc <6 %, significantly increased the incidence of hypoglycemia, and thus to HBAc maintained at between 6 to 7 % is more suitable, studies have shown that in the absence of perceived low blood glucose control in patients relax, make HBAc maintained at around 8.0 % and remain three months, low blood sugar can damage against the regulation of hormone partially reversed, and reduce the incidence of non-detect hypoglycemia;
- determination of liver and kidney function: liver and kidney dysfunction may significantly increase the incidence of hypoglycemia, diabetes and kidney function should be fully understood, a reasonable choice of treatment and reduce the incidence of hypoglycemia, hypoglycemia Zheyi helps to merge cause analysis;
- blood ketone bodies, lactate and osmometry: help with DKA, HHC and identification of lactic acidosis.

Such as brain dysfunction should be further examination, do CT, EEG examination to confirm the location of the lesion.

Treatment

Emergency treatment: For acute hypoglycemia, or low blood sugar coma to quickly lift the state of emergency.

Glucose: The most rapid and effective, the preferred formulation for the emergency treatment of. Light can oral glucose water, amount, weight are required intravenous injection of 50 % glucose solution 40~100 ml, may need to be repeated until the patient awake. Of particular note is in the patient awake, often need to continue intravenous 10 % glucose solution, which is

maintained at a high level of blood sugar, such as 200 mg/dl, and close observation for several hours or one day, otherwise the patient may once again caught in an emergency state.

Glucagon: The usual dose is 0.5~1.0 mg, subcutaneously, intramuscularly or intravenously. After treatment patients than awake within 5~20 min, otherwise it can be repeated dosing. Glucagon action quickly, but to maintain a relatively short time, usually 1~1.5 h, after the patient must eat or intravenous glucose, to prevent recurrence of hypoglycemia.

Glucocorticoids: If the patient's blood sugar has remained at 200 mg/dl level for some time but still delirious. May consider intravenous hydrocortisone 100 mg, once every four hours, a total of 12 hours, in order to facilitate the recovery of patients.

Mannitol: The above reaction is still poorly treated or coma longer duration, it may be accompanied by severe cerebral edema, you can use 20% of mannitol therapy.

In a timely manner to determine the cause and incentives for effective lifting of the state of low blood sugar and prevent recurrent disease is extremely important. Methods include diet conditioning, avoid foods or drugs can cause hypoglycemia, the treatment of primary liver, kidney, gastrointestinal and endocrine disorders, removal of tumors caused by low blood sugar.

Diabetic ketoacidosis

Diabetic ketoacidosis (DKA) is an acute, major, life-threatening complication of diabetes that mainly occurs in patients with type 1 diabetes, but it is not uncommon in some patients with type 2 diabetes. This condition is a complex disordered metabolic state characterized by hyperglycemia, ketoacidosis, and ketonuria.

Dehydration and hyperosmolarity are usually present. All patients may not meet all the above criteria.

When considering the precipitating factors for the development of DKA, it is important to remember that DKA develops due to either an absolute or a relative absence of insulin. In Type 2 diabetes, it is usually a relative lack of insulin unlike that seen in Type 1 diabetics who usually manifest an absolute absence of insuluin.

Etiology

The most common scenarios for diabetic ketoacidosis (DKA) are underlying or concomitant infection (40 %), missed or disrupted insulin treatments (25 %), and newly diagnosed, previously unknown diabetes (15 %). Other associated causes make up roughly 20 % in the various scenarios.

Causes of DKA in type 1 diabetes mellitus include the following:

• In 25 % of patients, DKA is present at diagnosis of type 1 diabetes due to acute insulin deficiency (occurs in 25 % of patients);

• Poor compliance with insulin through the omission of insulin injections, due to lack of patient/guardian education or as a result of psychological stress, particularly in adolescents;

• Missed, omitted or forgotten insulin doses due to illness, vomiting or excess alcohol intake;

• Bacterial infection and intercurrent illness (eg, urinary tract infection [UTI]);

• Klebsiella pneumoniae (the leading cause of bacterial infections precipitating DKA);

• Medical, surgical, or emotional stress;

• Brittle diabetes;

• Idiopathic (no identifiable cause);

• Insulin infusion catheter blockage;

• Mechanical failure of the insulin infusion pump.

Causes of DKA in type 2 diabetes mellitus include the following:

• Intercurrent illness (eg, myocardial infarction, pneumonia, prostatitis, UTI);

• Medication (eg, corticosteroids, pentamidine, clozapine).

DKA also occurs in pregnant women, either with preexisting diabetes or with diabetes diagnosed during pregnancy. Physiologic changes unique to pregnancy provide a background for the development of DKA. DKA in pregnancy is a medical emergency, as mother and fetus are at risk for morbidity and mortality.

Pathophysiology

Diabetic ketoacidosis (DKA) is a complex disordered metabolic state characterized by hyperglycemia, ketoacidosis, and ketonuria. DKA usually occurs as a consequence of absolute or relative insulin deficiency that is accompanied by an increase in counter-regulatory hormones (ie, glucagon, cortisol, growth hormone, epinephrine). This type of hormonal imbalance enhances hepatic gluconeogenesis, glycogenolysis, and lipolysis.

Hepatic gluconeogenesis, glycogenolysis secondary to insulin deficiency, and counter-regulatory hormone excess result in severe hyperglycemia, while lipolysis increases serum free fatty acids. Hepatic metabolism of free fatty acids as an alternative energy source (ie, ketogenesis) results in accumulation of acidic intermediate and end metabolites (ie, ketones, ketoacids). Ketone bodies have generally included acetone, beta-hydroxybutyrate, and acetoacetate. It should be noted, however, that only acetone is a true ketone, while acetoacetic acid is true ketoacid and beta-hydroxybutyrate is a hydroxy acid.

Meanwhile, increased proteolysis and decreased protein synthesis as result of insulin deficiency add more gluconeogenic substrates to the gluconeogenesis process. In addition, the decreased glucose uptake by peripheral

tissues due to insulin deficiency and increased counter regulatory hormones increases hyperglycemia.

Ketone bodies are produced from acetyl coenzyme A mainly in the mitochondria within hepatocytes when carbohydrate utilization is impaired because of relative or absolute insulin deficiency, such that energy must be obtained from fatty acid metabolism. High levels of acetyl coenzyme A present in the cell inhibit the pyruvate dehydrogenase complex, but pyruvate carboxylase is activated. Thus, the oxaloacetate generated enters gluconeogenesis rather than the citric acid cycle, as the latter is also inhibited by the elevated level of nicotinamide adenine dinucleotide (NADH) resulting from excessive beta-oxidation of fatty acids, another consequence of insulin resistance/insulin deficiency. The excess acetyl coenzyme A is therefore rerouted to ketogenesis.

Progressive rise of blood concentration of these acidic organic substances initially leads to a state of ketonemia, although extracellular and intracellular body buffers can limit ketonemia in its early stages, as reflected by a normal arterial pH associated with a base deficit and a mild anion gap.

When the accumulated ketones exceed the body's capacity to extract them, they overflow into urine (ie, ketonuria). If the situation is not treated promptly, a greater accumulation of organic acids leads to frank clinical metabolic acidosis (ie, ketoacidosis), with a significant drop in pH and bicarbonate serum levels. Respiratory compensation for this acidotic condition results in rapid shallow breathing (Kussmaul respirations).

Ketones/ketoacids/hydroxy acids, in particular, beta-hydroxybutyrate, induce nausea and vomiting that consequently aggravate fluid and electrolyte loss already existing in DKA. Moreover, acetone produces the fruity breath odor that is characteristic of ketotic patients.

Glucosuria leads to osmotic diuresis, dehydration and hyperosmolarity. Severe dehydration, if not properly compensated, may lead to impaired renal function. Hyperglycemia, osmotic diuresis, serum hyperosmolarity, and metabolic acidosis result in severe electrolyte disturbances. The most characteristic disturbance is total body potassium loss. This loss is not mirrored in serum potassium levels, which may be low, within the reference range, or even high.

Potassium loss is caused by a shift of potassium from the intracellular to the extracellular space in an exchange with hydrogen ions that accumulate extracellularly in acidosis. Much of the shifted extracellular potassium is lost in urine because of osmotic diuresis.

Patients with initial hypokalemia are considered to have severe and serious total body potassium depletion. High serum osmolarity also drives water from intracellular to extracellular space, causing dilutional hyponatremia. Sodium also is lost in the urine during the osmotic diuresis.

Typical overall electrolyte loss includes 200–500 mEq/L of potassium, 300–700 mEq/L of sodium, and 350–500 mEq/L of chloride. The combined effects of serum hyperosmolarity, dehydration, and acidosis result in increased osmolarity in brain cells that clinically manifests as an alteration in the level of consciousness.

Many of the underlying pathophysiologic disturbances in DKA are directly measurable by the clinician and need to be monitored throughout the course of treatment. Close attention to clinical laboratory data allows for tracking of the underlying acidosis and hyperglycemia, as well as prevention of common potentially lethal complications such as hypoglycemia, hyponatremia, and hypokalemia.

Hyperglycemia

The absence of insulin, the primary anabolic hormone, means that tissues such as muscle, fat, and liver do not uptake glucose. Counterregulatory hormones, such as glucagon, growth hormone, and catecholamines, enhance triglyceride breakdown into free fatty acids and gluconeogenesis, which is the main cause for the elevation in serum glucose level in DKA. Beta-oxidation of these free fatty acids leads to increased formation of ketone bodies.

Overall, metabolism in DKA shifts from the normal fed state characterized by carbohydrate metabolism to a starvation state characterized by fat metabolism.

Secondary consequences of the primary metabolic derangements in DKA include an ensuing metabolic acidosis as the ketone bodies produced by beta-oxidation of free fatty acids deplete extracellular and cellular acid buffers. The hyperglycemia-induced osmotic diuresis depletes sodium, potassium, phosphates, and water.

Hyperglycemia usually exceeds the renal threshold of glucose absorption and results in significant glucosuria. Consequently, water loss in the urine is increased due to osmotic diuresis induced by glucosuria. This incidence of increased water loss results in severe dehydration, thirst, tissue hypoperfusion, and, possibly, lactic acidosis, or renal impairment.

See Hyperosmolar Hyperglycemic State for more complete information on this topic.

Dehydration and electrolyte loss

Typical free water loss in DKA is approximately 6 liters or nearly 100 mL/kg of body weight. The initial half of this amount is derived from intracellular fluid and precedes signs of dehydration, while the other half is from extracellular fluid and is responsible for signs of dehydration.

Patients often are profoundly dehydrated and have a significantly depleted potassium level (as high as 5 mEq/kg body weight). A normal or even elevated serum potassium concentration may be seen due to the extracellular shift of potassium in acidotic conditions, and this very poorly ref-

lects the patient's total potassium stores. The serum potassium concentration can drop precipitously once insulin treatment is started, so great care must be taken to repeatedly monitor serum potassium levels. Urinary loss of keto-anions with brisk diuresis and intact renal function also may lead to a component of hyperchloremic metabolic acidosis.

Symptoms

The most common early symptoms of DKA are the insidious increase in polydipsia and polyuria. The following are other signs and symptoms of DKA:

- Malaise, generalized weakness, and fatigability;
- Nausea and vomiting; may be associated with diffuse abdominal pain, decreased appetite, and anorexia;
- Rapid weight loss in patients newly diagnosed with type 1 diabetes;
- History of failure to comply with insulin therapy or missed insulin injections due to vomiting or psychological reasons or history of mechanical failure of insulin infusion pump;
- Decreased perspiration;
- Altered consciousness (eg, mild disorientation, confusion); frank coma is uncommon but may occur when the condition is neglected or with severe dehydration/acidosis.

Signs and symptoms of DKA associated with possible intercurrent infection are as follows:

- Fever;
- Coughing;
- Chills;
- Chest pain;
- Dyspnea;
- Arthralgia.

On examination, general findings of DKA may include the following:

- Ill appearance;
- Dry skin;
- Labored respiration;
- Dry mucous membranes;
- Decreased skin turgor;
- Decreased reflexes;
- Characteristic acetone (ketotic) breath odor;
- Tachycardia;
- Hypotension;
- Tachypnea;
- Hypothermia.

In addition, evaluate patients for signs of possible intercurrent illnesses such as MI, UTI, pneumonia, and perinephric abscess. Search for signs of infection is mandatory in all cases.

Inspection

Initial and repeat laboratory studies for patients with DKA include the following:

- Serum glucose levels;
- Serum electrolyte levels (eg, potassium, sodium, chloride, magnesium, calcium, phosphorus);
- Bicarbonate levels;
- Amylase and lipase levels;
- Urine dipstick;
- Ketone levels;
- Serum or capillary beta-hydroxybutyrate levels;
- ABG measurements;
- CBC count;
- BUN and creatinine levels;
- Urine and blood cultures if intercurrent infection is suspected;
- ECG (or telemetry in patients with comorbidities).

Note that high serum glucose levels may lead to dilutional hyponatremia; high triglyceride levels may lead to factitious low glucose levels; and high levels of ketone bodies may lead to factitious elevation of creatinine levels.

Imaging tests.

Radiologic studies that may be helpful in patients with DKA include the following:

- Chest radiography: To rule out pulmonary infection such as pneumonia;
- Head CT scanning: To detect early cerebral edema; use low threshold in children with DKA and altered mental status;
- Head MRI: To detect early cerebral edema (order only if altered consciousness is present.

Do not delay administration of hypertonic saline or mannitol in those pediatric cases where cerebral edema is suspected, as many changes may be seen late on head imaging.

Treatment

Treatment of ketoacidosis should aim for the following:

- Fluid resuscitation;
- Reversal of the acidosis and ketosis;
- Reduction in the plasma glucose concentration to normal;
- Replenishment of electrolyte and volume losses;
- Identification the underlying cause.

Pharmacotherapy

Regular and analog human insulins are used for correction of hyperglycemia, unless bovine or pork insulin is the only available insulin.

Medications used in the management of DKA include the following:

- Rapid-acting insulins (eg, insulin aspart, insulin glulisine, insulin lispro);

- Short-acting insulins (eg, regular insulin);
- Electrolyte supplements (eg, potassium chloride);
- Alkalinizing agents (eg, sodium bicarbonate).

Hydration Therapy: Patients with DKA are invariably dehydrated and foremost in the treatment of DKA is restoration of the intravascular volume. Estimates of fluid deficits in the decompensated diabetic is 4–10 litres (usually 5–6 liters).

Initially, one to two liters of normal saline is given within the first hour followed by 1 L/hour for the next several hours. This initial management should be guided by the patient's general condition and response, with more or less fluid as indicated. After the first 3–4 hours, as the clinical condition of the patient improves, with stable blood pressure and good urine output, fluids should be changed to 1⁄2 normal saline at 250–500 cc an hour for 3–4 hours. Ongoing reassessment is critical. When dehydration does not appear severe, rehydration rates one-half as fast as the above regimens have been studied with good results and less electrolyte disturbance. This may be considered in those patients who appear only minimally dehydrated.

Insulin: Insulin has several actions in managing DKA. These include decreasing glucagon release from the pancreas and limiting glucagon's effect on the liver. This decreases gluconeogenesis and ketogenesis in the liver. Additionally, the insulin allows glucose uptake and utilization by peripheral tissues.

Current recommendations for insulin therapy include an initial intravenous insulin bolus of 0.1–0.4 U/kg body weight followed by a continuous intravenous infusion of 0.1 U/kg/hour. This usually amounts to 5–10 U/hour in the typical adult. The goal of treatment should be to lower the serum glucose of the patient by 75–100 mg/dl/hour. The rate can be doubled every hour if this rate is not achieved. Ongoing difficulty in controlling the glucose levels may indicate the presence of a severe underlying infection.

The ketosis and acidaemia in DKA takes longer to resolve than the elevation of glucose. For this reason, the insulin therapy must be continued even when the blood glucose levels have improved to near normal levels. When the glucose levels begin to approach 250 mg/dl, insulin infusions are continued, but the fluid composition is changed to include 5–10 % dextrose in water to avoid hypoglycemia.

Potassium: Regardless of the serum potassium level at the initiation of therapy, during treatment of DKA there is usually a rapid decline in the potassium concentration in the patient with normal kidney function.

General recommendations for potassium replacement are as follows. If the patient does not have marked elevation of potassium, is not in renal failure, the ECG does not show evidence of hyperkalemia beyond peaked T-waves, potassium therapy is initiated once good urine output has been established. Potassium is usually added to the intravenous fluids and should

not exceed 40 mEq per liter of intravenous fluids. Some authors recommend splitting the potassium replacement as KCL and KPO4.

The potassium level should be checked every one to two hours initially since this is when the greatest shift occurs. After the patient has stabilized the potassium can be checked every 6–8 hours.

Bicarbonate Therapy. The use of bicarbonate in the treatment of DKA is highly controversial. Current recommendations for bicarbonate therapy are as follows. Use of bicarbonate is considered unnecessary when the blood pH is greater than 7.1. For those patients with pH between 6.9 and 7.1 there are no clear guidelines. If the patient is elderly or very debilitated there may be some benefit to give bicarbonate in this range. If it is given it should be given with the intravenous fluids and not as IV push. For those patients with pH below 6.9 bicarbonate should be added to the intravenous fluids. One ampuole of bicarbonate has 44 mEq of sodium bicarbonate. Attempts should be made to create an isotonic fluid with the bicarbonate being added to either one-half normal saline or D5W.

Phosphate: Phosphate is normally an intracellular substance that is dragged out of the cell during DKA.

Similarly like potassium, at presentation the serum levels may be normal, high, or low while the total body supply is depleted. Despite this depletion, replacement of phosphate has not been shown to affect patient outcome and routine replacement is not recommended

Antibiotics. In most instances, it may be necessary to start treatment with a broad spectrum antibiotic without waiting for specific proof of the presence of an infection and a culture and sensitivity test.

Frequency of Monitoring in DKA

• In severely ill patients, electrolytes including potassium, pH and serum creatinine should be monitored hourly for the first 4 hours then at 4 hourly intervals, over the next 12 hours.

• Vital signs (e.g., pulse, temperature, respiration, blood pressure and mental status) should be monitored with similar frequency.

• Once the glucose is <15 mmol/L, the pH is near normal and the patient is eating and drinking well, the frequency of laboratory blood tests can be reduced further. At this stage, start checking the urine for ketones to ascertain whether these are clearing.

Hyperosmolar nonketotic diabetic coma

Hyperosmolar nonketotic diabetic coma (hyperosmolar nonketotic diabetic coma, called hyperosmolar coma) is another type of diabetes clinical acute metabolic disorder, is caused by high blood sugar due to plasma osmolality increased, severe dehydration and progressive consciousness No significant ketoacidosis, often accompanied by varying degrees of neurologic manifestations of the clinical syndrome. More common in elderly patients with type 2 diabetes, a good age for 50 to 70 years old, about two-

thirds of patients with no prior history of diabetes onset, or only mild symptoms. The high mortality rate of the disease, early reports of up to 40 % to 70 % mortality rate is about 50 % of domestic reports ~69.2 %. Therefore, early detection and timely rescue of the most important.

Etiology

- Stress and infections: such as cerebrovascular accident, acute myocardial infarction, acute pancreatitis, gastrointestinal bleeding, trauma, surgery, stroke, or low temperature stress, infections, particularly upper respiratory tract infections, urinary tract infections, the most common evoked.
- Insufficient intake of water: the elderly decreased sensitivity to thirst center, bedridden patients, patients with mental disorders, or coma and can not take the initiative, such as water intake of young children.
- Excessive water loss and dehydration: such as severe vomiting, diarrhea, severe burn patients, nerve, surgical treatment of dehydration, dialysis therapy.
- High sugar intake and input: such a high intake of sugary drinks and high-sugar foods, when the diagnosis is unknown when or missed a lot of intravenous glucose solution, complete intravenous nutrition, and the use of sugar solution hemodialysis or peritoneal dialysis etc., especially in patients with certain endocrine disorders of glucose metabolism disorders merger, such as hyperthyroidism, acromegaly, Cushing's syndrome, pheochromocytoma, and so were more likely to be induced.
- Drugs: Many drugs can become incentives, such as the extensive use of corticosteroids, thiazide or furosemide (Lasix) and other diuretics, propranolol, phenytoin, chlorpromazine, cimetidine, glycerol, and other immunosuppressants such as azathioprine, can cause or aggravate the body's insulin resistance, leaving blood sugar, dehydration worse, some drugs such as thiazide diuretics also inhibit insulin secretion and reduce insulin sensitivity, which can induce HNDC.
- Other: such as acute and chronic renal failure, diabetes, kidney disease, due to the glomerular filtration rate, clearance of glucose also decreased, but also an incentive.

In short, almost all clinical HNDC patients have significant predisposing factors, animal experiments also illustrate hyperosmolar coma occurred, in addition to the existing base of diabetes there is a clear precipitating factors and should be removed when the query and treatment.

Pathophysiology

The first is the foundation HNDC onset patients have varying degrees of impaired glucose metabolism, the basic cause is insulin deficiency and dehydration, in some incentive effect, so that the original glucose metabolism increased, insulin response to glucose reduction, reduced insulin secretion, glycogen breakdown increases significantly elevated blood sugar, severe hyperglycemia and diabetes caused by osmotic diuresis, resulting in a lot

of water and electrolytes lost from the kidney, since many patients with active water uptake ability of obstacles and varying degrees of renal impairment, so high blood sugar, dehydration and high plasma osmolality gradually increased, eventually leading to hypertonic that HNDC state, normal plasma osmolality is maintained at 280~300 mmol / L, which is mainly provided by the blood Na^+, but can also cause blood glucose was significantly higher plasma osmotic pressure.

HNDC time, high blood sugar and high urine caused by osmotic diuresis, urine osmolality by approximately 50 % to maintain glucose in urine, it is often much higher than in patients with dehydration severe electrolyte loss, coupled with many patients with active water intake to maintain body water balance decreased renal insufficiency, resulting in more severe hyperglycemia and dehydration, which coupled with the often accompanied by hypokalemia, one is able to cause the secretion of cortisol, catecholamines and glucagon increased; the other is to further inhibit the secretion of insulin, continue to increase high blood sugar, creating a vicious cycle, resulting HNDC occur.

HNDC differs DKA, mostly often no or only mild ketoacidosis; common in the elderly; high blood sugar, dehydration and severe DKA relatively high plasma osmolality, resulting in the mechanism for this difference is not fully understood currently considered:

- HNDC patients with relatively high insulin secretion, sufficient to inhibit fat breakdown and formation of ketone bodies, but can not prevent other incentives caused by elevated blood sugar, also suggested that no significant difference between the two, and some plasma insulin levels in patients presenting HNDC Low unpredictable.
- Patient plasma growth hormone and catecholamine levels below ketoacidosis, and these two hormones are strong promote lipolysis and ketone body production role, but the same was reported between these two hormones in both free significant difference.
- Patients with severe dehydration, and severe dehydration is not conducive to the formation of ketone bodies elderly, the body of water reserves is lower than in younger patients, they often have reduced sensitivity to thirst center and renal dysfunction, and thus dehydration more than the ketosis severe acidosis, fatty acid β-oxidation and formation of ketone bodies are required to participate in the water, so that severe dehydration can affect the production of ketone bodies. In addition, the blood concentration can cause severe dehydration, renal excretion of glucose disorder, caused by a more severe hyperglycemia.
- Ketogenic liver dysfunction patients, renal excretion of sugar capacity decreased, resulting in high blood sugar is very light and ketosis was found in some patients the plasma non-esterified fatty acid levels without ketosis, ketogenic support liver function there are obstacles, normal In high

glucose per hour from the urine glucose 20 g, so blood sugar normal renal function is generally not more than 27.8 mmol/L (500 mg/dl), about 90 % of patients with this disease kidney disease, row sugar function barriers that severely elevated blood sugar.

• Severe hyperglycemia may be generated between the mutual antagonism and ketones someone tries to explain this disease patients with severe hyperglycemia but no obvious ketoacidosis, and the patient has significant ketoacidosis ketoacidosis And this phenomenon is relatively low blood glucose levels, to the removal of the dog pancreas injection of glucose, ketone bodies can inhibit the body; and a large number of fatty acid oxidation, patients plasma NAD/NADH ratio decreased, gluconeogenesis necessary lower levels of alanine, thereby inhibiting glycogen gluconeogenesis.

Clinical data show that, HNDC with DKA are not two distinct symptoms, there are a variety of intermediate between the two types, forming a continuous morbid spectrum, the two are the two extremes of a continuous spectrum of disease only, clinical Many patients are also seen HNDC there ketosis or ketoacidosis, and many plasma osmolality was significantly higher in patients with diabetic ketoacidosis, as it was reported abroad, 275 cases of diabetes, high blood sugar in A & E, 32 % pure HONK another 18 percent in the same time there are significant hypertonic ketoacidosis, and typical ketoacidosis in 26 % while there hyperosmolar state, visible, there is overlap between the NHDC and DKA, call overlap syndrome, for example, with DKA HNDC overlap syndrome, or DKA HNDC overlap syndrome with typical ketoacidosis, can not deny HNDC diagnosis; severe hyperglycemia, hyperosmolar state, sometimes also seen in ketosis acid poisoning patients, which is in clinical work, should be paid.

Symptoms

Hyperosmolar nonketotic diabetic coma symptoms of the common symptoms of polyuria, polydipsia, fatigue loss of appetite lack of dehydration and circulatory failure consciousness confusion blurred consciousness.

History. Mostly elderly, occurs in 50 to 70 years, the prevalence of roughly the same for men and women, about half of the known diabetes, history of heart disease by about 30 %; about 90 % suffer from kidney disease.

Diabetes type: type 2 diabetes; few can type 1 diabetes, multiple coexisting with DKA; can occur even in Cushing's syndrome, acromegaly patients with diabetes.

The mode of onset. Slow, patient in a few days to several weeks before the onset of clinical manifestations are often more severe symptoms of diabetes include polydipsia polydipsia, polyuria, weakness, dizziness, lack of appetite and vomiting.

Dehydration and peripheral circulatory failure. Patients often have severe symptoms of dehydration, dry and visible skin elasticity loss, sunken

eyes, dry tongue and may have longitudinal cracks, when patients with peripheral circulatory failure, rapid and weak pulse, jugular vein filling supine insufficiency, orthostatic low blood pressure, systolic blood pressure after standing down low when compared with supine 1.3 kPa (10 mmHg) above, has been in a state of shock when the number of patient visits, but severe dehydration, physical examination can be no sweat when found, although some patients with severe dehydration, but hyperosmolar state plasma induce intracellular fluid out, to add volume, may mask the severity of the loss, leaving the blood pressure remained normal.

Neurological symptoms and signs. About half of patients vague awareness, a/3 in a coma, some patients thus be misdiagnosed as cerebral vascular accident, even mistakenly enter hypertonic glucose solution or dehydrating agent, prompting sicker, HNDC patients with disorders of consciousness or not its extent is mainly determined in plasma osmolality level and speed, and blood sugar level also has a certain relationship, but not with the degree of acidosis relations abroad was found that when patients effective plasma osmolality than 320 mmol/L, to psychiatric symptoms such as apathy, lethargy; more than 350 mmol/L, the 40 % of patients may have blurred consciousness or coma, but some patients effective plasma osmolality is slowly rising, though already more than 400 mmol/L during treatment, the patient is still in the clear state.

Neurological signs: as grand mal seizures, transient paralysis, muscle relaxation or involuntary contraction, aphasia, ipsilateral hemianopia, visual disturbances, nystagmus, visual hallucinations, loss of sensation bust, Babinski sign was positive and central fever, etc. These signs suggesting that patients may be related to the cerebral cortex, or cortex due to dehydration, blood concentration, or blood clots caused by lower damage related to these changes through effective treatment and more can be reversed or returned to normal, there are a few within a period of time after the HNDC corrected still left nerves, some of the symptoms of mental disorders.

Associated with the onset of signs and symptoms. Patients may have high blood pressure, kidney disease, coronary heart disease manifestations such as the original; pneumonia, urinary tract infections, pancreatitis induced disease manifestations; manifestations and complications of cerebral edema, thrombosis, blood clots, such as the patient's body temperature normal or slightly elevated, such as hypothermia, the tips may be associated with acidosis and (or) sepsis, should be sufficient attention.

Inspection

Hyperosmolar nonketotic diabetic coma inspection

The blood and urine: this disease with significant hyperglycemia, the main features of urine, blood sugar more than 33 mmol/L (600 mg/dl), urine strongly positive patients, such as dehydration or severe renal impairment renal sugar When the threshold increases, urine or not showing strong positive, but negative urine rare.

Blood electrolytes: Under normal circumstances, normal or elevated serum sodium, can also be reduced; normal or decreased serum potassium, can also be increased; overall sodium and potassium are reduced, patients can have loss of calcium, magnesium, phosphorus, sodium and potassium levels in patients, depending on the amount and distribution of its lost status intracellular, and the extent of their loss, HNDC, the majority of patients with loss of sodium and potassium loss each 300~500 mmol/L, foreign literature, loss of the patient's total sodium, potassium and chlorine are 5~10 mmol/kg, 5~15 mmol/kg and 5~7 mmol/kg body weight.

HNDC patient occurs when hypertonic diuretic renal tubular sodium reabsorption is inhibited, and the intracellular water to the outside of the transfer of cells, so that tends to reduce sodium, it was found that elevated blood sugar every 5.6 mmol/L (100 mg/dl), serum sodium will drop about 1.7 mmol/L, in addition, can drink blood sodium levels drop, the increase in plasma chylomicrons, can also result in reduced sodium false, contrary to the above factors cause elevated serum sodium, hyperosmolar diuretic water loss than the loss of sodium, decreased blood volume stimulates aldosterone secretion caused by the discharge of sodium retention and potassium, to varying degrees, these factors determine the level of sodium, the same, hyperosmolar diuretic, loss of appetite and increased secretion of adrenal hormones can make blood potassium decreased, blood volume expansion after treatment, blood sugar to drop and transfer of intracellular potassium can also cause a further decline in serum potassium; and dehydration, renal blood concentration failure, but also can increase potassium levels, so HONK untreated patients may have different sodium and potassium levels.

BUN and creatinine: often significantly higher, reflecting the extent to severe dehydration and kidney dysfunction, blood urea nitrogen (BUN) of up to 21~36 mmol/L (60~100 mg/dl), creatinine (Cr) up to 163~600 mmol/L (1.7~7.5 mg/dl), BUN/Cr ratios up 30:1 above (normal more in 10:1~20:1), BUN and Cr were increased in patients with a poor prognosis, After effective treatment, serum BUN and Cr decreased more significantly, some patients will not recover to the normal range, i.e., it indicates that they have renal insufficiency prior to the occurrence of HNDC.

Plasma osmolality: HNDC significantly increased is an important feature and diagnosis is based on direct measurement of plasma osmolality, but commonly used in clinical following formula:

Plasma osmolality (mmol/L) = 2 ([Na +] [K+]) (glucose mg/dl)/18 (BUNmg/dl)/2.8.

Wherein the sodium and potassium ions in units of mmol/L, glucose and BUN units of mg/dl, as glucose molecular weight 180, BUN molecules containing two nitrogen atoms, the atomic weight of nitrogen and 28, so as to mg/dl into mmol/L, respectively, will be divided by the value of blood glucose and BUN 18 and 2.8, glucose, BUN also be directly used mmol/L

calculation, normal plasma osmolality was 280~300 mmol/L, such as more than 350 mmol/L is can be diagnosed as hypertonic.

Because BUN freely through the cell membrane, can not constitute an effective osmotic pressure of extracellular fluid, it is argued that most of BUN omitted in the calculation, and the calculation of effective plasma osmolality, is calculated as follows:

Effective plasma osmolality (mmol/L) = 2 ([Na+] [K+]) glucose (mmol/L).

Effective osmotic pressure greater than 320 mmol/L is the permeability, effective in patients with higher plasma osmolality HNDC 320 mmol/L.

The acid-base imbalance: About half of patients with mild or moderate metabolic, high anion gap acidosis, increased anion gap of about 1 times, blood [HCO3-] much higher than 15 mmol/L, pH value of more than 7.3, increased organic acid radical anions are mainly lactic acid and the like, can also contain minor amounts of sulfate and phosphate.

Anion gap is calculated as follows:

Anion gap = [Na +] [K +] - [CI -] - [HCO3-]

Where units of mmol/L, such as [HCO3-] item with CO2CP (vol/dl), said value can be divided by 2.24 and fold into mmol/L, as in standard conditions, 1 mmol any volume of gas are 22.4 L, normal anion gap of 12~16 mmol/L.

Blood and urine ketone ketone: Blood ketone were normal or slightly elevated, more quantitative determination of no more than 50 mg/dl, as measured by the dilution method, with little more than the plasma diluted to 1:4 continued to show a positive reaction, ketone more negative or weakly positive.

Other: HNDC patient's white blood cell count often increased, up to 50×10^9/L; hematocrit increased, reflecting dehydration and hemoconcentration.

According to the condition selected for urine culture, chest X-ray and ECG and other changes.

Treatment

Treatment principles: General basically with DKA, including search and remove incentives; close observation of changes in a timely manner and to the implementation of effective treatments vary; the key is to correct severe dehydration treatment to restore blood volume, correct and hyperosmolar state relevant pathophysiological changes; including rehydration therapy, the use of insulin, correct electrolyte imbalance and acidosis.

Rehydration: aggressive rehydration is the first and important HNDC key measures of treatment, the prognosis of patients with a decisive role. For patients with simple rehydration HNDC can make blood sugar dropped 1.1 mmol/L per hour (20 mg/dl). The total amount of fluid: the degree of water loss in patients with more severe than HNDC DKA. Estimated up to 1/8 or more before the onset of 1/4 or body fluid weight. However, due to absorption effects of high blood sugar, and its loss of signs often not fully reflect the extent of water loss.

Rehydration of the total estimate:

• accurate estimate difficult, can be generally 10 to 12 % of patient body weight estimates, more than the total amount of complement in 6~10 L, was slightly higher than the estimated value of the total loss. This is because taking into account in treatment, there are a lot of liquid from the kidney, respiratory and skin missing sake.

• estimation of the patient's plasma osmolality by water loss, calculated as follows:

The patient's loss of water (L) = [patient plasma osmolality (mmol/L) -300]/[300 (normal plasma osmolality)]×weight (kg)×0.6.

(Since the measured plasma osmolality require specialized osmotic pressure meter, according to a formula you need to wait for the results of the electrolyte, it is not commonly used in clinical practice).

Rehydration Category: include physiological saline, saline or semi infiltration glucose, dextran, whole blood or plasma, 5 % glucose solution and glucose solution and the like. For the choice of the type of infusion, to sum up, in principle, as appropriate, according to the following three kinds of options:

– if the patient has normal or low blood pressure, serum Na^+<150 mmol/L were first treated with isotonic, if the volume recovery, increased blood pressure and plasma osmolality is still down and then switch to hypotonic solution;

– normal blood pressure and blood Na^+>150 mmol/L, could begin that with hypotonic; If the patient has continued to shock or systolic blood pressure <10.7 kPa who start up in addition to the outside should be interrupted isotonic plasma or whole blood transfusion.

• NS: 0.9 % saline osmotic pressure of 308 mmol/L, can be quickly and effectively add volume, correct shock, improve kidney function and lower blood sugar. But a large number of patients can use saline sodium and chlorine elevated blood in HNDC therapy, should be noted. Saline can be used at the start of treatment, the test results have not yet paid off;

– low blood pressure, serum sodium 50 mmol/L when, no matter the level of plasma osmolality, can use saline;

– such as low blood pressure, even slightly higher serum sodium 150 mmol/L still with saline, supplemented gastrointestinal pay, and to monitor changes in serum sodium per hour;

– during treatment as the first semi infiltration solution, when plasma osmolality fell 330 mmol/L after also should use saline.

• semi-infiltration solution include: 0.45 % saline and 2.5 % glucose solution, the osmotic pressure was 154 and 139 mmol/L, can be quickly and effectively reduced plasma osmolality and correct dehydration within the cells, in the absence of significant hypotension and sodium >150 mmol/L, the solution should be used semi-permeability. Some people think that a lot of hypotonic solution can reduce excessive plasma osmolality, they can not

effectively maintain blood volume, as well as cause hemolysis, cerebral edema and delayed corrective shock hazard, so most people advocate infiltration solution should be used with caution and a half. But there are a lot of people think that saline does not provide free water, 5 % glucose solution may aggravate high blood sugar, and half the risk of infiltration solution application is not as large as estimated, without too much worry about adverse reactions, as long as no significant low blood pressure, under close observation in moderation half exudate, improvement of the disease is more beneficial.

• whole blood, plasma and dextran: HNDC patients with severe hypotension (SBP lower than 80 mmHg, namely 10.7 kPa) or shock patients, use:

– whole blood, plasma or saline containing 10 % dextran 500~ 1000 ml be corrected. If both sodium >150 mmol/L, may be combined in whole blood (or plasma) and semi infiltration solution. Some even advocate the whole blood (or plasma) with 5 % glucose solution in combination. Also suggested that the use of whole blood may increase the likelihood of the occurrence of thromboembolism, should be noted.

– possibility dextran cause heart failure, pulmonary edema and renal failure, have heart disease in patients with renal dysfunction and severe dehydration should be used with caution. In addition, dextran may affect blood typing and cross-matching blood transfusion if possible, should be carried out the inspection, re-use dextran.

• 5 % glucose solution and 5 % glucose solution: 5 % glucose solution (osmotic pressure 278 mmol/L), although isotonic, but the blood glucose concentration is about 50 times, 5 % glucose saline (osmolarity 586 mmol/L) The osmotic pressure is about 2 times the normal serum osmolality. Thus, both early treatment should not be used in order to avoid increasing hyperglycemia, hypernatremia and hyperosmolar state. However, if the patient is very high sodium, high blood sugar and not be under the premise with enough insulin, using a 5 % glucose solution. In HNDC treatment when blood sugar drops to 14 mmol/L (250 mg/dl) or so, you should use a 5 % glucose solution, if both low plasma osmolality, also with 5 % glucose solution.

Induction, the infusion can be roughly the kind of choice:

Where normal or low blood pressure, serum Na^+<150 mmol/L were, first with isotonic (0.9 % NaCl). Blood Na^+ >155 mmol/L may first choose hypotonic (0.45 % NaCl).

If the patient systolic blood pressure <80 mmHg person except an isotonic solution outside should complement intermittent output of plasma or whole blood.

Infusion rate principle is to slow down after the first one hour input 500~1000 ml, or head 4 h input should fill 1/3 of the total amount of fluid, head 8 h fill 1/2 of the total liquid volume (including head 4 h inputs) day plus urine, make up the balance within 24 hours.

Rehydration method

• the majority of claims in accordance with the actual situation of the patient slightly different. Under normal circumstances, before the 2 h lose saline treatment 2 L; within the following 6 h, based on the patient's blood pressure, serum sodium and plasma osmolality case every 2 h infusion 1 L; treatment of from 8 to 24 h, can infusion every 2 h 0.5 L, until the fluids to make up. As for the type of treatment after 2 h rehydration is based on the patient's condition. Still high plasma osmolality may use half infiltration solution, plasma osmolality fell 330 mmol/L or blood pressure is still low by using saline, blood sugar dropped to 14 mmol/L were available 5 % glucose solution, glucose and plasma osmolality were lower by 5 % glucose solution may be used and so on.

In order to promptly correct hypovolemic shock, 1/3 should be entered within 4 h total rehydration after admission, should make up the remaining two-thirds within 24 h after admission. Due to a large amount of fluid, and often need to open up more than one venous access, and as far as possible through oral rehydration or gastrointestinal tube.

• gastrointestinal fluids: HNDC time, especially in elderly patients, as supplemented by the gastrointestinal tract, this method is effective and relatively simple and safe, you can reduce the amount of intravenous fluid replacement and mitigate the adverse reactions caused by a large number of intravenous infusion. Can best be administered orally; not be oral (coma), you can seize the opportunity to add the next tube. After the warm water can give speeds of up to 1~2 L/h, urine output >30 ml/h, can be added per 500 ml of 10 % potassium chloride 10~20 ml. In conjunction with the use of 0.9 % sodium chloride solution intravenously, may be given before 4 h 1/3 of the total, 250~500 ml per hour speed is appropriate (taking into account the state of cardiac function and the elderly), could later be 2~3 h 500 ml, until the blood sugar to 13.9 mmol/L, the change lose 5 % dextrose or sugar water (ibid.).

• If by the infusion 4~6 h still no urine may be intravenous furosemide 40 mg.

Poor and cardiac function were elderly, in order to prevent fluid overload caused by congestive heart failure, pulmonary edema and cerebral edema and other complications during the infusion, patients should be observed in the urine, jugular vein distention, and conduct lung auscultation, central venous pressure and hematocrit measurements when necessary to guide rehydration.

Insulin therapy

• a flexible, where appropriate, use of insulin: HNDC patient during treatment, when compared with DKA sensitive to insulin, the insulin dose required is small than ketoacidosis. Some have argued before the infusion

of 2 L, even in the whole course of treatment does not give insulin alone rehydration therapy HNDC. Generally tend to start giving the insulin, but the dose should be small and closely observing changes in blood and urine, and flexible use of insulin.

• low-dose insulin therapy: HNDC patients currently still advocate the outset given small doses of insulin therapy.

Intramuscular injection: first intramuscular injection of human insulin (RI) 20 U, hour after intramuscular injection of 4~6 U, until the blood sugar dropped to 14 mmol/L (250 mg/dl) or less. If low blood pressure in patients with intramuscular injections of insulin absorption is not good, you should not use the intramuscular method, but should be used intravenous method.

Intravenous drip method: is the most commonly used method in clinical, flexible, convenient, blood sugar steady decline, fewer adverse reactions, DKA has a section detailing. In HNDC patient advocate to someone for the first time the impact of the amount, that is the first to RI (human insulin) 10~16 U / times, intravenous injection, after hourly 0.1 U/kg body weight continuous infusion. Once the blood sugar to 14~17 mmol/L (250~300 mg/dl), the insulin dose can be reduced to hourly 0.05 U/kg body weight. Commonly used dose of insulin 4~6 U/h intravenous infusion, blood glucose decreased rate per hour 3.3~5.6 mmol/L (60~100 mg/dl) is appropriate. Under the premise of the amount of fluid has been complement, such as within the first 4 hours of treatment, blood glucose decreased less than an hour 2 mmol/L (36 mg/dl), or on the contrary increased, indicating inadequate insulin dose, the amount of insulin should be increased by 50 to 100 %. Therefore, the general requirements within the first 12 h of treatment, it is best to measure blood sugar every 2 h 1 times. Should be alert to the rapid decline in blood sugar levels is not conducive to correct hypovolemia, and will increase the risk of hypoglycemia. When the blood sugar to 14~17 mmol/L, you should use 5 % (or 10 %) of glucose, while insulin dosage to 2~3 U/h intravenous infusion, or 3~4 U/h intramuscular injection. After a period of stability can be further changed to intramuscular or subcutaneous injection of insulin several times a day, and finally to gradually return to pre-treatment HNDC disease. In HNDC patient, as long as adequate rehydration, after the closure of insulin hyperosmolar state rarely repeated.

Correct electrolyte imbalances HNDC, patients with electrolyte imbalances, primarily the loss of sodium and potassium loss, but also have varying degrees of loss of calcium, magnesium and phosphorus.

• Sodium supplement: general fluid (add saline) at the same time, more sodium imbalance can be corrected.

• Potassium: HNDC main task is to correct electrolyte imbalances.

– potassium preparations: potassium chloride solution used in the clinic, when it was thought it might aggravate existing HNDC hyperchlo-

remia, it was argued with potassium acetate, phosphorus and potassium phosphate is not high when available. Try and oral potassium citrate solution, safe and convenient, but also reduce the amount of intravenous potassium and adverse reactions.

– potassium timing: Choose the right time is very important. Initially there is hyperkalemia, should begin after rehydration and insulin therapy 2~4 h and then potassium; early treatment were normal or decreased serum potassium should be at the beginning of treatment that is potassium. According urine potassium. There is too little urine intravenous potassium may lead to dangerous hyperkalemia, urine only when more than 50 ml/h, at least more than 30 ml/h, the only intravenous potassium.

Potassium amount: 10% potassium chloride used clinically 30 ml (KCl 3 g) added to 1000 ml liquid, at 4~6 h within the input, 24 h can supply KCl 4~6 g. Another suggestion when serum potassium > 5 mmol/L, 4~5 mmol/L, 3~4 mmol/L and < 3 mmol/L when/potassium per hour were 0, 10, 20 and 30 mmol, potassium expected within 36 h 300 mmol.

Note: Due HNDC body potassium lost patients in the treatment process, only partially replenished and corrected, and called upon HNDC correct oral potassium should continue at least 1 week. Infusion (K) process, should pay attention to the monitoring of serum potassium to prevent the occurrence of hyperkalemia or hypokalemia. Be reviewed every 2~3 h potassium 1, and the use of electrocardiographic monitoring changes in serum potassium.

• with respect to calcium, phosphorus, magnesium: no domestic clinical applications. It was suggested HNDC patients should supplement conventional magnesium and calcium gluconate prevent hypomagnesemia and hypocalcemia induced convulsions. If the patient serum phosphorus is low, can be intravenous or oral potassium phosphate buffer, should make phosphorus observe changes in serum phosphorus and calcium, alert hypocalcemia occurred. 10. HNDC correct acidosis acidosis generally not heavy, which may increase the blood acid or lactic acid levels.

After a mild acidosis generally adequate rehydration and insulin therapy, tissue hypoxia with renal insufficiency correction, without the use of basic drugs, acidosis can be corrected. At this point, if improperly administered basic drugs, but may aggravate hypokalemia and cause convulsions.

When CO2CP less than 11 mmol/L (25 vol/dl), can enter the 1.4 % $NaHCO_3$ 400 ml, 4~6 h after review, if CO_2CP has been restored to 11~14 mmol/L (25~30 vol/dl) or more, stop the fill base.

Hypertonic NaHCO3 solution should not be used in patients HNDC, to use 1.4 % isotonic. Sodium lactate, lactic acidosis may increase, and it is not for HNDC treatment.

Other therapeutic measures

• removal of incentives: if infection is suspected, when the central venous pressure were measured or catheter placement should be based on

estimates of the different kinds of pathogens, using a sufficient amount of suitable antibiotics. It is necessary to pay attention to avoid the overuse of antibiotics, especially antibiotics, may affect renal function, but also note that some antibiotics can affect the potency of insulin, such as erythromycin and other basic antibiotics, insulin can not enter through the same path.

- Oxygen: If PaO2 <10.7 kPa (80 mmHg), give oxygen.
- Tube placement: HNDC when many patients in a coma or semi-coma, aspiration of gastric tube should be placed as soon as possible. Through the tube, the patient can make warm water or warm saline, but also through the tube potassium.
- Catheterization: First, patients should be encouraged to take the initiative to urinate, as 4h not urinate, you should place the catheter.

Uremic encephalopathy

Uremic encephalopathy is an organic brain disorder. It develops in patients with acute or chronic renal failure, usually when the estimated glomerular filtration (eGFR) level falls and remains below 15 mL/min.

Manifestations of this syndrome vary from mild symptoms (eg, lassitude, fatigue) to severe symptoms (eg, seizures, coma). Severity and progression depend on the rate of decline in renal function; thus, symptoms are usually worse in patients with acute kidney injury. Prompt identification of uremia as the cause of encephalopathy is essential because symptoms are readily reversible following initiation of dialysis.

Causes of uremic encephalopathy

Uremic encephalopathy may occur in a patient affected with acute kidney injury or chronic kidney failure of any etiology.

Uremia describes the final stage of progressive renal insufficiency and the resultant multiorgan failure. It results from accumulating metabolites of proteins and amino acids and concomitant failure of renal catabolic, metabolic, and endocrinologic processes. No single metabolite has been identified as the sole cause of uremia. Uremic encephalopathy (UE) is one of many manifestations of renal failure (RF).

Pathophysiology

Uremic encephalopathy has a complex pathophysiology, and many toxins that accumulate in kidney failure may be contributive. Parathyroid hormone (PTH) likely contributes to uremic encephalopathy.

Secondary hyperparathyroidism, which occurs in kidney failure, causes an increase in calcium content in the cerebral cortex. In animal models with uremia, EEG changes were typical of those observed in patients with renal failure. In uremic patients with secondary hyperparathyroidism, EEG changes have been shown to improve after medical suppression of PTH or parathyroidectomy.

The specific mechanism by which PTH causes disturbance in brain function is unclear, but it may be caused by increases in intracellular concentration of calcium in brain cells. However, since the encephalopathy improves with dialysis, which does not have a marked effect on PTH levels, hyperparathyroidism is not thought to be the main cause.

Another theory about the etiology of uremic encephalopathy suggests imbalances of neurotransmitter amino acids within the brain. During the early phase of uremic encephalopathy, plasma and cerebrospinal fluid (CSF) determinations indicate that levels of glycine increase and levels of glutamine and GABA decrease; additionally, alterations occur in metabolism of dopamine and serotonin in the brain, which may lead to early symptoms (eg, sensorial clouding). As uremia progresses, it has been proposed that the accumulation of guanidino compounds results in activation of excitatory N-methyl-D-aspartate (NMDA) receptors and inhibition of inhibitory GABA receptors, which may cause myoclonus and seizures.

A study of acute kidney injury in mice found evidence of a blood-brain barrier disruption from such injury, with increased neuronal pyknosis and microgliosis. In addition, proinflammatory chemokines were increased in brain tissue.

Numerous other uremic toxins may contribute to uremic encephalopathy, but there has been a notable lack of research in this area. Although the encephalopathy correlates roughly with BUN level, urea is not itself thought to be causative.

Symptoms

Early symptoms

- Anorexia;
- Nausea;
- Restlessness;
- Drowsiness;
- Diminished ability to concentrate;
- Slowed cognitive functions;
- More severe symptoms;
- Vomiting;
- Emotional volatility;
- Decreased cognitive function;
- Disorientation;
- Confusion;
- Bizarre behavior.

As uremic encephalopathy progresses, patients may develop myoclonus, asterixis, seizures, stupor, and coma.

Inspection

Check: electrolytes, BUN, creatinine, and glucose.

Markedly elevated BUN and creatinine levels are seen in uremic encephalopathy.

Obtain serum electrolyte and glucose measurements to rule out hyponatremia, hypernatremia, hyperglycemia, and hyperosmolar syndromes as the cause of encephalopathy.

Obtain a complete blood cell count to detect leukocytosis, which may suggest an infectious cause and determine whether anemia is present. (Anemia may contribute to the severity of mental alterations.)

Obtain serum calcium, phosphate, and PTH levels to determine the presence of hypercalcemia, hypophosphatemia, and severe hyperparathyroidism, which cause metabolic encephalopathy.

Serum magnesium levels may be elevated in a patient with renal insufficiency, particularly if the patient is ingesting magnesium-containing antacids. Hypermagnesemia may manifest as encephalopathy.

Order a toxicology screen in all patients.

Medication levels

Determine drug levels because medications may accumulate in patients with kidney failure and contribute to encephalopathy (eg, digoxin, lithium).

Some medications cannot be detected and are excreted by the kidney. These may also accumulate in patients with kidney failure, resulting in encephalopathy (eg, penicillin, cimetidine, meperidine, baclofen).

Treatment

No medications are specific to the treatment of encephalopathy.

The presence of uremic encephalopathy in a patient with either acute kidney injury or chronic kidney failure is an indication for the initiation of dialytic therapy (ie, hemodialysis, peritoneal dialysis, continuous renal replacement therapy). After beginning dialysis, the patient generally improves clinically, although EEG findings may not improve immediately.

In patients with end-stage renal disease (ESRD), EEG abnormalities generally improve after several months but may not completely normalize.

Address the following factors when treating uremic encephalopathy, which are also included in the standard care of any patient with ESRD:

– adequacy of dialysis;

– correction of anemia;

– regulation of calcium and phosphate metabolism.

Hepatic encephalopathy

Hepatic encephalopathy (HE) is a serious liver disease or extensive portal – venous shunt due to metabolic disorders based on the central nervous system dysfunction syndrome. The main clinical manifestations of consciousness, abnormal behavior, and coma.

Causes of hepatic encephalopathy

Complications of liver disease (55 %):

Hepatic encephalopathy is mainly seen in various types of liver cirrhosis (hepatitis cirrhosis most common), but also by the door – venous shunt surgery caused severe viral hepatitis, acute toxic hepatitis, and drug-induced liver disease or fulminant hepatic failure stage, Primary liver cancer, acute fatty liver of pregnancy, severe biliary tract infections can also cause hepatic encephalopathy.

Other diseases (35 %):

Hepatic encephalopathy in particular door – shunt encephalopathy often obvious incentive, as gastrointestinal bleeding, a lot of potassium diuretic, ascites, high-protein diet, sleep sedatives, anesthetics, constipation, uremia, surgery, infection and so on.

Hepatic encephalopathy, accompanying the acute onset of severe hepatic synthetic dysfunction, is the hallmark of acute liver failure (ALF). Symptoms of encephalopathy in ALF are graded using the same scale used to assess encephalopathy symptoms in cirrhosis. The encephalopathy of cirrhosis and ALF share many of the same pathogenic mechanisms. However, brain edema plays a much more prominent role in ALF than in cirrhosis. The brain edema of ALF is attributed to increased permeability of the blood-brain barrier, impaired osmoregulation within the brain, and increased cerebral blood flow. The resulting brain cell swelling and brain edema are potentially fatal. In contrast, brain edema is rarely reported in patients with cirrhosis. The encephalopathy of ALF is not covered in this article but is addressed in Acute Liver Failure.

A nomenclature has been proposed for categorizing hepatic encephalopathy.

Type A hepatic encephalopathy describes encephalopathy associated with A cute liver failure. Type B hepatic encephalopathy describes encephalopathy associated with portal-systemic B ypass and no intrinsic hepatocellular disease. Type C hepatic encephalopathy describes encephalopathy associated with C irrhosis and portal hypertension or portal-systemic shunts. Type C hepatic encephalopathy is, in turn, subcategorized as episodic, persistent, or minimal.

Pathophysiology

A number of theories have been proposed to explain the development of hepatic encephalopathy in patients with cirrhosis. Some investigators contend that hepatic encephalopathy is a disorder of astrocyte function. Astrocytes account for about one third of the cortical volume. They play a key role in the regulation of the blood-brain barrier. They are involved in maintaining electrolyte homeostasis and in providing nutrients and neurotransmitter precursors to neurons. They also play a role in the detoxification of a number of chemicals, including ammonia.

It is theorized that neurotoxic substances, including ammonia and manganese, may gain entry into the brain in the setting of liver failure. These neurotoxic substances may then contribute to morphologic changes in astrocytes. In cirrhosis, astrocytes may undergo Alzheimer type II astrocytosis. Here, astrocytes become swollen. They may develop a large pale nucleus, a prominent nucleolus, and margination of chromatin. In ALF, astrocytes may also become swollen. The changes of Alzheimer type II astrocytosis are not seen in ALF. But, in contrast to cirrhosis, astrocyte swelling in ALF may be so marked as to produce brain edema. This may lead to increased intracranial pressure and, potentially, brain herniation.

Hepatic encephalopathy may also be thought of as a disorder that is the end result of accumulated neurotoxic substances in the brain. Putative neurotoxins include short-chain fatty acids; mercaptans; false neurotransmitters, such as tyramine, octopamine, and beta-phenylethanolamines; manganese; ammonia; and gamma-aminobutyric acid (GABA).

Symptoms

Two broad categories of hepatic encephalopathy are covert (CHE) and overt (OHE) hepatic encephalopathy; CHE is particularly associated with poor outcomes.

Grading of the symptoms of hepatic encephalopathy is performed according to the so-called West Haven classification system, as follows:

Grade 0 – Minimal hepatic encephalopathy (also known as CHE and previously known subclinical hepatic encephalopathy); lack of detectable changes in personality or behavior; minimal changes in memory, concentration, intellectual function, and coordination; asterixis is absent.

Grade 1 – Trivial lack of awareness; shortened attention span; impaired addition or subtraction; hypersomnia, insomnia, or inversion of sleep pattern; euphoria, depression, or irritability; mild confusion; slowing of ability to perform mental tasks.

Grade 2 – Lethargy or apathy; disorientation; inappropriate behavior; slurred speech; obvious asterixis; drowsiness, lethargy, gross deficits in ability to perform mental tasks, obvious personality changes, inappropriate behavior, and intermittent disorientation, usually regarding time.

Grade 3 – Somnolent but can be aroused; unable to perform mental tasks; disorientation about time and place; marked confusion; amnesia; occasional fits of rage; present but incomprehensible speech.

Grade 4 – Coma with or without response to painful stimuli.

With minimal hepatic encephalopathy, patients may have normal abilities in the areas of memory, language, construction, and pure motor skills. However, patients with minimal hepatic encephalopathy demonstrate impaired complex and sustained attention. They may have delay in the choice reaction time. They may even have impaired fitness to drive. Typically, patients with minimal hepatic encephalopathy have normal function on standard mental status

testing but abnormal psychometric testing. Neurophysiologic tests in common use are the number connection test, the digit symbol test, the block design test, and tests of reaction times to light or sound (eg, critical flicker test).

Patients with grade 1 hepatic encephalopathy typically demonstrate decreased short-term memory and concentration on mental status testing. However, grade 1 hepatic encephalopathy may be difficult to diagnose. The presence of disorientation and asterixis are characteristic of grade 2 hepatic encephalopathy.

The borderline between covert and overt hepatic encephalopathy is being redrawn. Until recent years, the term "overt" hepatic encephalopathy was applied to patients with grades 1 through 4 encephalopathy. Now, patients with grades 0 and 1 hepatic encephalopathy are said to be "covert"; patients with grades 2 through 4 hepatic encephalopahty are said to be "overt".

In terms of the physical examination finding of asterixis, it must be emphasized that the flapping tremor of the extremities is also observed in patients with uremia, pulmonary insufficiency, and barbiturate toxicity.

Some patients with hepatic encephalopathy show evidence of fetor hepaticus, a sweet musty aroma of the breath believed to be secondary to the exhalation of mercaptans.

Other potential physical examination findings include hyperventilation and decreased body temperature.

Inspection

• Hyperammonemia.

Chronic hepatic encephalopathy, especially door – shunt encephalopathy patients have elevated blood ammonia, acute liver failure due to more normal blood ammonia encephalopathy.

• Liver function test abnormalities.

• EEG.

Prodromal period is normal, any subsequent abnormal rhythms typical for slow change occurs 4–7 times per universality of θ wave, and some also out 1–3 times per second, δ wave, while the sides of coma symmetrical high amplitude δ waves appear.

• Evoked potentials.

Is a potential in vitro can be recorded, synchronized discharge reaction by various external stimuli after sensory afferent neurons in the brain network, according to the different stimuli can be divided into visual evoked potential (VEP), auditory evoked potentials (AEP) and somatic evoked potential (SEP), evoked potentials animal model of hepatic encephalopathy recorded, according to the specific condition Qianshen have changed, then this technology will be used to study patients with hepatic encephalopathy, hepatic encephalopathy may think VEP to varying degrees including subclinical encephalopathy make objective and accurate diagnosis, the sensiti-

vity than any other method, the present study indicate VEP check different people, at different times changed so much, the lack of specificity and sensitivity, as a simple and effective intelligence test.

• Simple quiz.

Now that the intelligence tests for early diagnosis of subclinical hepatic encephalopathy, including encephalopathy most useful tests include several digital, digital connection, a simple calculation, writing, word formation, drawing, building blocks, take the five-pointed star with Matchstick, of which digital The most common connection test, the result is easy to measure, to facilitate the follow-up.

Treatment

• The elimination of incentives

Certain factors may induce or aggravate hepatic encephalopathy. Cirrhosis, drug half-life in the body, reducing clearance, increased sensitivity to the brain encephalopathy patients should avoid use of narcotic, analgesic, hypnotic, sedative and other drugs, such as improper use, there may be lethargy and even coma. When patients have convulsions when the rampage or disable morphine and its derivatives, paraldehyde, chloral hydrate, pethidine and quick barbiturates, can use reduction (constant 1/2 or 1/3) and the West Pan, scopolamine, and reduce the frequency of administration. Or promethazine, antihistamines such as chlorpheniramine instead. Must be timely and upper gastrointestinal bleeding, infection control, avoiding fast and a lot of potassium diuretic and paracentesis. Note correcting water, electrolyte and acid-base balance.

• Reduce the generation and absorption of intestinal poison.

Diet: protein begin within a few days of fasting. 5.0~6.7 kJ daily calorie supply and enough vitamins to sugar as the main food, coma can not eat through a nasogastric tube for food. Fat may delay gastric emptying should use less. Nasal fluid preferably with 25 % sucrose or glucose solution, per mL of heat production 4.2 J. Daily added 3~6 g of essential amino acids. Should not stop nasal gastric emptying in favor of deep venous catheter infusion of 25 % glucose solution to maintain nutrition. In a large number of glucose infusion process, we must be vigilant hypokalemia, heart failure and cerebral edema. After conscious, you can gradually increase the protein to 40~60 g/d. To use plant protein for the best. Plant protein containing methionine, less aromatic amino acids, including branched-chain amino acids are more, and can increase fecal nitrogen excretion. In addition, non-absorbent fibers containing vegetable protein, is intestinal bacteria ferment acid production in favor of exclusion of ammonia, and favorable laxative, it applies to patients with hepatic encephalopathy.

Enema or cathartic: keep the stool through the intestines, remove intestinal food plot, hemorrhage or other nitrogenous substances to reduce the generation and absorption of ammonia available saline or weak acid solution

(eg dilute acetic acid solution) enema, avoid the use of alkaline solution. Or oral or nasal 30~60 ml of 25 % magnesium sulfate catharsis. First, the treatment is particularly useful in patients with systemic shunt encephalopathy with lactulose coma add 500 ml water 500 ml enema as – Acute door.

Inhibition of bacterial growth: oral neomycin 2~4 g/d or choose clothes paromomycin, kanamycin, ampicillin have good effect. Patients with long-term service in the minority neomycin hearing or renal impairment occurs, it should not take more than one neomycin month. Oral metronidazole 0.2 g, 4 times/d, equal efficacy and neomycin, suitable for those with poor kidney function.

Lactulose (lactulose), after oral administration in the colon by bacteria decomposed into lactic acid and acetic acid to make acidic the intestine, thereby reducing the formation of ammonia and absorption. Jiyong neomycin or need for long-term treatment of patients with lactulose or sorbitol as the drug of choice of milk. Lactulose is a syrup, dose 30~100 ml/d, orally 3 times, start small dose, to be adjusted to 2 to 3 times a day defecation, fecal pH 5~6 is appropriate. Adverse reactions fullness, abdominal cramps, nausea, and vomiting. Milk and sorbitol are similar disaccharide lactulose, tablets or syrup can be made, easy to preserve, and the treatment of metabolic and lactulose same dose 30 g a day, 3 times a day orally. In recent years, found that the lactose in the colon lactase deficiency in the population, but also reduces bacterial fermentation acid after fecal pH, reduce the ammonia content, for the treatment of hepatic encephalopathy, and lactulose same effect, but the price is cheaper.

- Promote the metabolic clearance of toxic substances, correct disorders of amino acid metabolism.

Reducing ammonia drugs:

- potassium glutamate (each 6.3 g/20 ml, potassium 34 mmol) and monosodium glutamate (each 5.75 g/20 ml, sodium 34 mmol), each with four, adding glucose solution intravenously, 1~2 times/d. Potassium glutamate, depending on the ratio of serum sodium, potassium, sodium concentration and the disease may be less potassium agent oliguria, sodium agent obvious caution when ascites and edema.
- 10~20 g arginine adding glucose intravenously 1 times/d, this medicine can promote the synthesis of urea, acidic drugs for patients with high blood's pH.
- such as glycine or sodium benzoate may be combined with enteral glutamine residue quality of nitrogen to form hippuric acid excreted by the kidneys, thus reducing blood ammonia. Treatment of acute door – shunt encephalopathy with lactulose effect quite. Each oral dose of 5 g, 2 times/d and enteral glutamine acid, forming toxic horse by renal excretion of uric acid, can also reduce blood ammonia concentration.

• α-ketoglutarate ornithine and ornithine aspartate ammonia were significantly reduced role. Lowering drugs on ammonia recurrent chronic portosystemic shunt encephalopathy better for severe hepatitis due to acute hepatic coma invalid.

Liver with amino acid infusion (branched chain amino acids): oral or intravenous infusion of amino acid infusion liver (branched-chain amino acids), amino acid-based mixture of amino acid metabolism in theory can correct imbalances in the brain to suppress false the formation of neurotransmitters, but the door shunt encephalopathy efficacy remains controversial. (3) GABA/BZ receptor antagonist compound:

GABA receptor antagonist bicuculline existing (bicuculline) benzodiazepine receptor antagonist flumazenil for (flumazenil). Bicuculline large adverse reactions, can not be used clinically. Flumazenil 1~2 mg intravenous infusion can improve symptoms of encephalopathy and somatic evoked potentials, but a few hours after stopping recurrence of symptoms.

Artificial liver: treatment with charcoal, resins and other blood perfusion or polyacrylonitrile dialysis, removing blood ammonia and other toxins, for acute and chronic hepatic encephalopathy have a certain effect.

• Liver Transplantation

Orthotopic liver transplantation provides a new therapeutic approach for a variety of end-stage liver disease.

• Other symptomatic treatment

– correcting water, electrolyte and acid-base balance: the total amount of liquid a day to not more than 2 500 ml appropriate. The amount of fluid in patients with cirrhosis and ascites should be added to the control (typically about urine plus 1 000 ml), in order to avoid hemodilution, aggravated hyponatremia coma. Promptly correct potassium and alkalosis, potassium chloride supplement were; alkalosis were available arginine salt solution intravenously.

– protect brain cell function: reduce intracranial temperature with ice caps, in order to reduce energy consumption and protect the brain cell function.

– to maintain airway patency: deep coma, should tracheotomy expectoration oxygen.

– prevention and treatment of cerebral edema: intravenous hypertonic glucose, mannitol and other dehydrating agent to combat cerebral edema.

– to prevent bleeding and shock: bleeding tendency, intravenous infusion of vitamin K1 or blood transfusion to correct shock, hypoxia and prerenal uremia.

– peritoneal or hemodialysis: azotemia is reason as hepatic encephalopathy, peritoneal or hemodialysis may be useful.

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Навчальне видання

СУЧАСНА ПРАКТИКА ВНУТРІШНЬОЇ МЕДИЦИНИ З НЕВІДКЛАДНИМИ СТАНАМИ

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