

COMMON NEUROLOGICAL PROBLEMS IN ICU

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55/M

- ◉ Chronic smoker
- ◉ COAD with repeated admissions
- ◉ Admitted to ICU for COAD exacerbation and CO₂ narcosis
- ◉ Mechanically ventilated and sedated with high dose morphine + midazolam infusion due to difficult ventilation and agitation
- ◉ Prolonged weaning
- ◉ GCS 4T5, no focal neurological deficit
- ◉ Imp:

ACUTE DELIRIUM

Incidence

- ◉ 15-50% of the ICU patients, up to 80% if on MV

Features (1+2+3 or 1+2+4)

1. Acute change in mental state with fluctuating course
2. Inattention
3. Altered level of consciousness
4. Disorganized thinking

3 types

- ◉ Hyperactive (easy to detect but actually less common)
- ◉ Hypoactive (easy to miss and misdiagnosed as depression)
- ◉ Mixed (most common)

RISK FACTORS FOR ACUTE DELIRIUM IN ICU PATIENTS

Acute condition

- Severe illness
- Metabolic
 - hypo/hyperglycaemia
 - hypo/hypernatraemia
 - hypo/hyperthyroidism
 - Deranged liver / renal function
 - fever
- Dehydration
- Sepsis
- Hypoxaemia
- Brain lesion
- Convulsion

Iatrogenic/environmental

- Drugs
 - anti-cholinergics, sedatives, analgesics, antibiotics, steroids, antihistamines, antihypertensives, bronchodilators, diuretics, H2 blockers
- Physical restraints
- Tube feeding
- Urinary catheter
- Central lines

DETECTION OF DELIRIUM

- ◉ First of all, establish patient's pre-existing mental state!
 - Sedation monitoring
 - Delirium screening
 - Pain evaluation
 - Sleep monitoring

Assessment of Delirium in the Intensive Care Unit: Nursing Practices And Perceptions

John W. Devlin et al.

Am J Crit Care 2008;17:555-565

- ◉ A paper/Web-based survey was administered to 601 staff nurses working in 16 intensive care units at 5 acute care hospitals with sedation guidelines specifying delirium assessment in the Boston, Massachusetts area.

RESULTS

- 98% of nurses routinely assess sedation level, whereas only 47% assess for the presence of delirium.

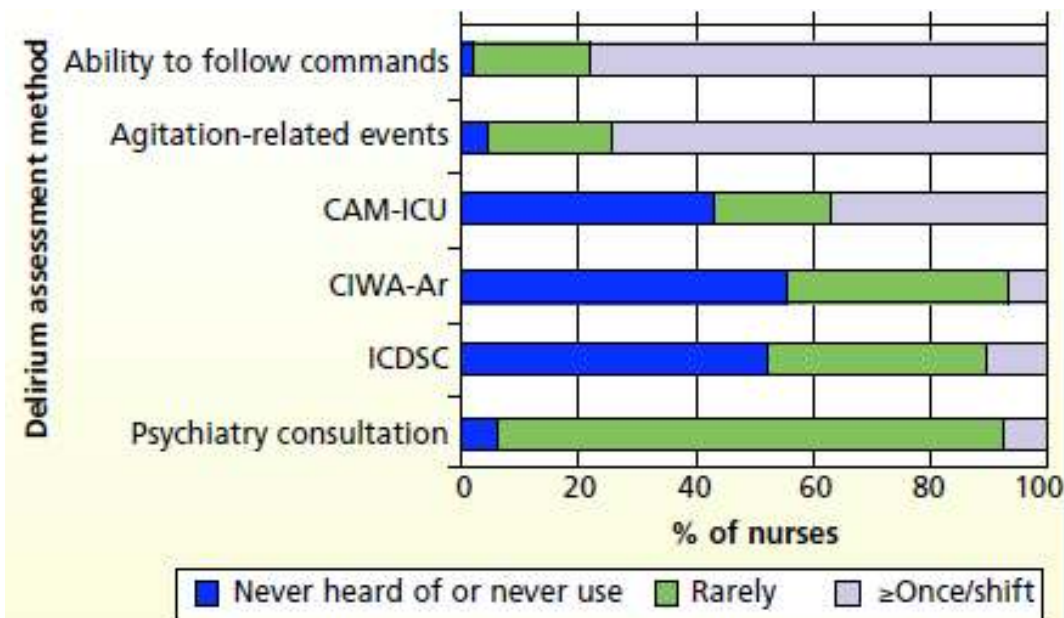


Figure 3 Frequency of use of possible methods of evaluating patients for delirium.

Abbreviations: CAM-ICU, Confusion Assessment Method for the Intensive Care Unit; CIWA-Ar, Clinical Institute Withdrawal of Alcohol Scale, Revised; ICDSC, Intensive Care Delirium Screening Checklist.

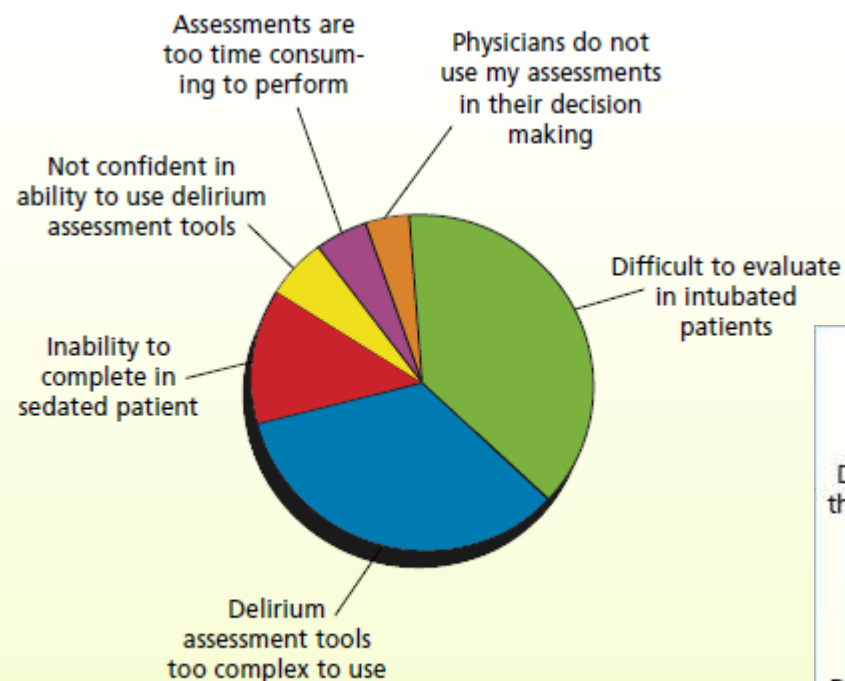


Figure 4 Barriers to the evaluation of delirium in intensive care patients.

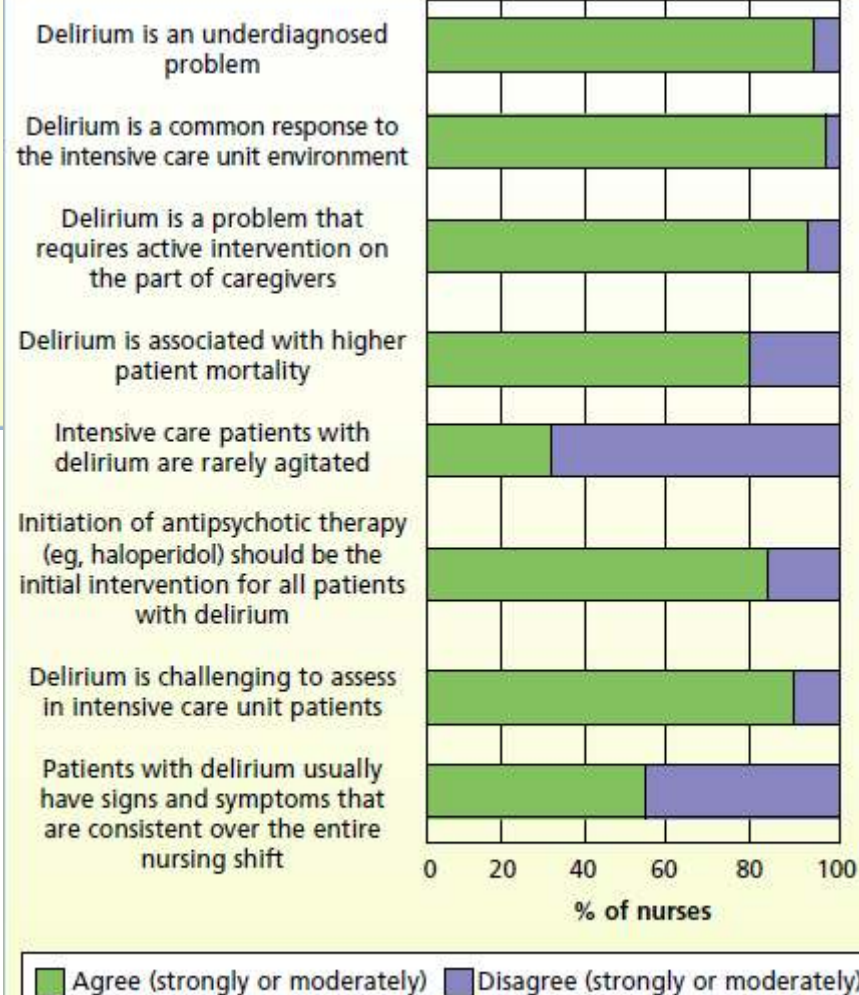
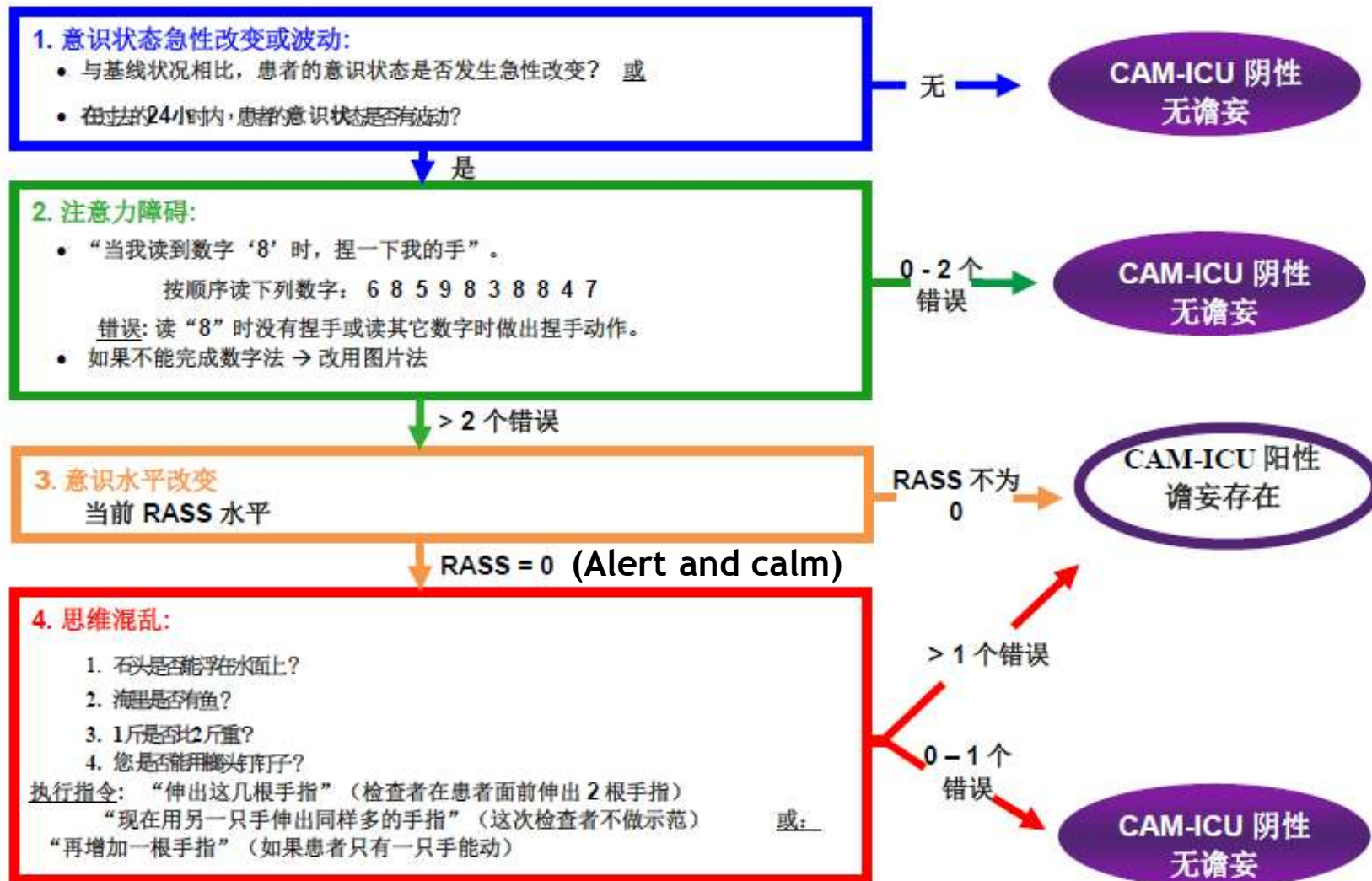


Figure 5 Nurses' perceptions of assessment of delirium.

ICU 意识模糊评估法 (CAM-ICU) 流程



TREATMENT

Non-pharmacological

- ◉ Attention to patient comfort
- ◉ Physical restraints
- ◉ Correct reversible risk factors
- ◉ Reassurance
- ◉ Provide orientation

Pharmacological

- ◉ Haloperidol
- ◉ Atypical antipsychotics
- ◉ Benzodiazepines
 - should be avoided except for withdrawal symptoms
- ◉ Dexmedetomidine
 - ?associated with shorter duration of delirium compared to midazolam

33/F

- ◉ History of epilepsy on multiple antiepileptics
- ◉ Admitted for breakthrough seizure the second time this year
- ◉ ?poor drug compliance
- ◉ Noted to have 3 episodes of GTC in medical ward in the past 30mins, drowsy all along with GCS E2V2M4
- ◉ Imp:

STATUS EPILEPTICUS

Definition

- ⦿ continuous seizure activity lasting >30 mins
 - has been suggested that the duration be reduced to 5 mins as typical fits rarely last >5 mins and that spontaneous termination is less likely in fits lasting >5 mins. In children spontaneously remitting fits may last longer up to 12 mins
- ⦿ two or more seizures without recovery of baseline consciousness

ETIOLOGY

- ◉ stroke
- ◉ intracranial infection
- ◉ Brain tumour
- ◉ hypoxic encephalopathy
- ◉ drug abuse and overdose
- ◉ electrolyte disturbance
- ◉ hypoglycaemia
- ◉ first presentation of primary epilepsy (by exclusion)

Patients without past history of epilepsy

- ◉ poor compliance
- ◉ change in antiepileptic drug dosage or type
- ◉ alcohol withdrawal
- ◉ pseudoseizure

Patients with past history of epilepsy

MAJOR TYPE OF SE

- Generalized convulsive SE

- GCSE is the most common and dangerous type. It requires immediate and aggressive treatment.

- Non-convulsive generalized SE

- Incidence in comatose patients varies from 8% of general medical patients to 30-40% of patients in neuro ICU. Occurs in significant proportion of patients with other cause for coma e.g. SAH, TBI

- Partial SE

COMPLICATIONS OF GCSE

- ◉ Hypoxia
- ◉ Lactic acidosis
- ◉ Hypercarbia
- ◉ Rhabdomyolysis, hyperkalaemia, ARF
- ◉ Hyperpyrexia
- ◉ Hypoglycaemia
- ◉ Hyper/hypotension
 - initial hypertension, subsequent hypotension
- ◉ Cardiac arrhythmias
 - Ischemic changes most common
- ◉ Neurogenic pulmonary edema
- ◉ Aspiration pneumonitis
- ◉ Increase ICP

INITIAL MANAGEMENT

- ⦿ ABC

- give O2, recovery position, avoid hypoxia and aspiration

- ⦿ Ensure iv access

- ⦿ Check Hstix, electrolytes (include Ca, Mg), ABG, urea, anticonvulsant level, tox screen

- ⦿ Give D50 50ml iv and/or 100mg thiamine iv where appropriate

ANTICONVULSANTS

Lorazepam

- ⊙ First line
- ⊙ Stop SE in 65% of cases
- ⊙ Longer duration of action

Phenytoin

- ⊙ Loading + maintenance
- ⊙ NEVER give as rapid bolus
 - Risk of malignant arrhythmia and tissue necrosis

Valproate

Levetiracetam (Keppra)

REFRACTORY SE

- ◉ Intubation
- ◉ EEG monitoring
- ◉ **Aim: EEG show seizure control or burst suppression**
- ◉ midazolam infusion
 - main disadvantage is tachyphylaxis with may necessitate a significant dose increase after 24-48h
- ◉ propofol infusion
 - main disadvantage is risk of propofol infusion syndrome for prolong and high dose use (>4 mg/kg/h for >24 hrs)
 - severe metabolic acidosis
 - rhabdomyolysis
 - cardiovascular collapse
- ◉ thiopentone infusion
 - main disadvantage is prolonged sedation due to long elimination half life and immuno-suppression effect

65/M

- ◉ DM, HT
- ◉ Chronic smoker
- ◉ Sudden onset R side weakness with aphasia 1 hour prior to admission
- ◉ CT brain: no ICH, L dense MCA sign
- ◉ Seen by stroke nurse in AED
- ◉ NIHSS 20

- ◉ Imp:

ACUTE ISCHEMIC STROKE

Initial management and considerations

- ◉ Are the symptoms related to stroke?
 - ◉ Where is the lesion?
 - ◉ What type of stroke is it?
 - ◉ Is the patient eligible to thrombolytic therapy?
-
- ◉ Emergency supportive care
 - ◉ Monitoring after thrombolysis

EMERGENCY SUPPORTIVE CARE OF STROKE PATIENTS

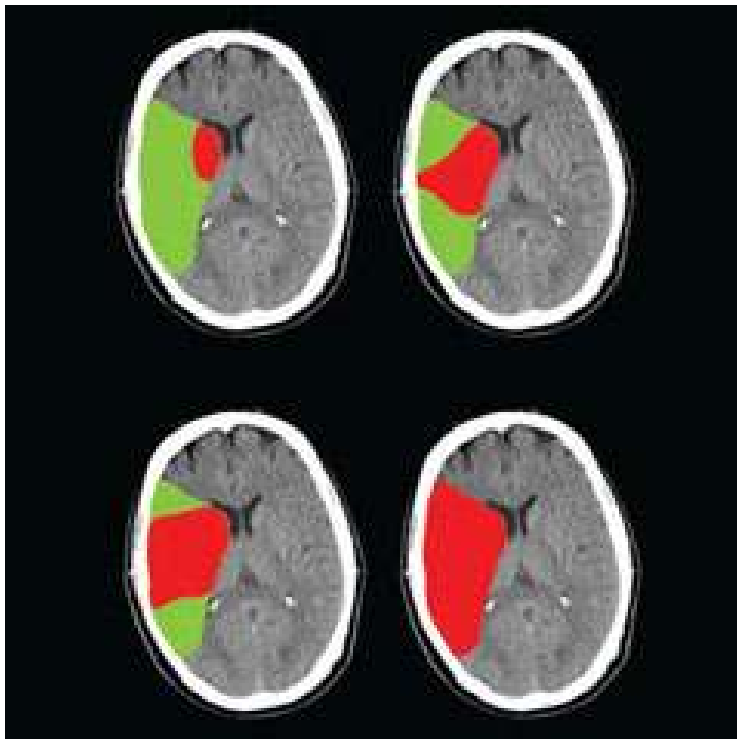
Avoid

- ◉ hypo / hypertension
- ◉ hypoxia
- ◉ electrolytes disturbance
- ◉ hypo / hyperglycemia
- ◉ aspiration
- ◉ hyperpyrexia

Action

- ◉ Intensive monitoring in ASU or ICU
- ◉ Definitive airway if suppressed GCS or risk of aspiration
- ◉ BP management
- ◉ Watch out for complications

PENUMBRA



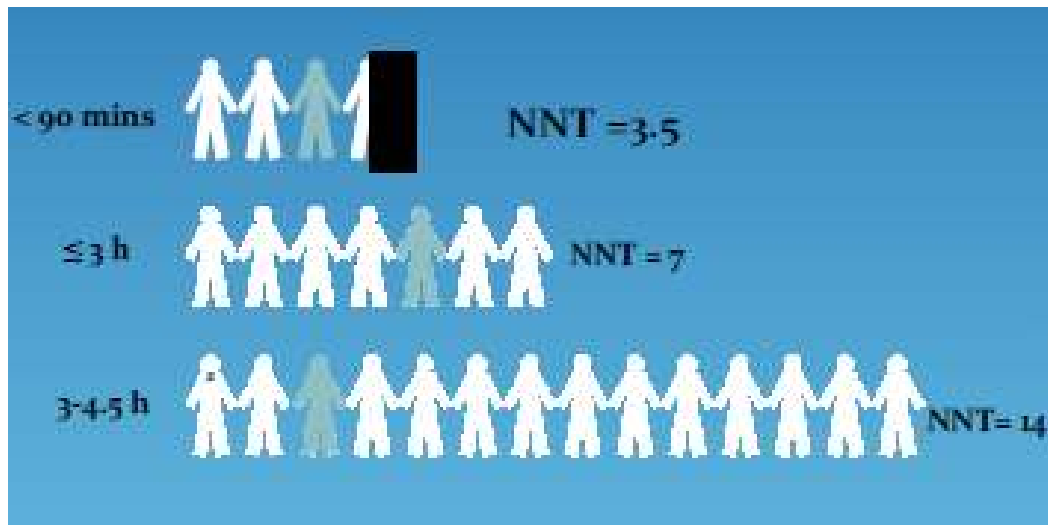
- ◉ Immediately after an ischemic stroke, a core of irreversibly damaged brain tissue (red) is surrounded by an area of viable but at risk tissue called the penumbra (green). Unless blood flow is restored quickly, the tissue within the penumbra will be lost.

TIME IS BRAIN!

- ◉ Consider IV rTPA for acute ischemic stroke if
 - Age >18
 - No absolute contraindications
 - Presented within 3hr of symptoms onset (level A evidence)
 - Presented between 3hr-4.5hr of symptoms onset, age <80, absence of DM and old CVA, NIHSS <25, no oral anticoagulant use (level B evidence)

TIME DEPENDENT EFFECT OF IV rTPA

Stroke onset



Risk of hemorrhage:

3.1%

5.6%

5.9%

Patients with NIHSS <20 and age <75 have higher likelihood of favorable outcome.

IV rTPA

Pre...

Contraindications

- ⦿ Main concern is risk of major hemorrhage
 - History of prior ICH
 - BP > 185/110 or requiring aggressive anti-HT agents
 - Large hypodensity on CT brain

Post...

Be alert for signs of ICH

- ⦿ Sudden increase BP, worsen GCS or neurology, severe headache, vomiting
 - Repeat CT scan

BP MANAGEMENT IN ACUTE ISCHEMIC STROKE

- Hypertension is a common physiological response to support brain perfusion in patient with acute ischemic stroke. Aggressive lowering of BP would impede perfusion in the penumbra and is associated with poorer outcome.
- Relief patient's discomfort, sooth anxiety, empty the bladder etc.

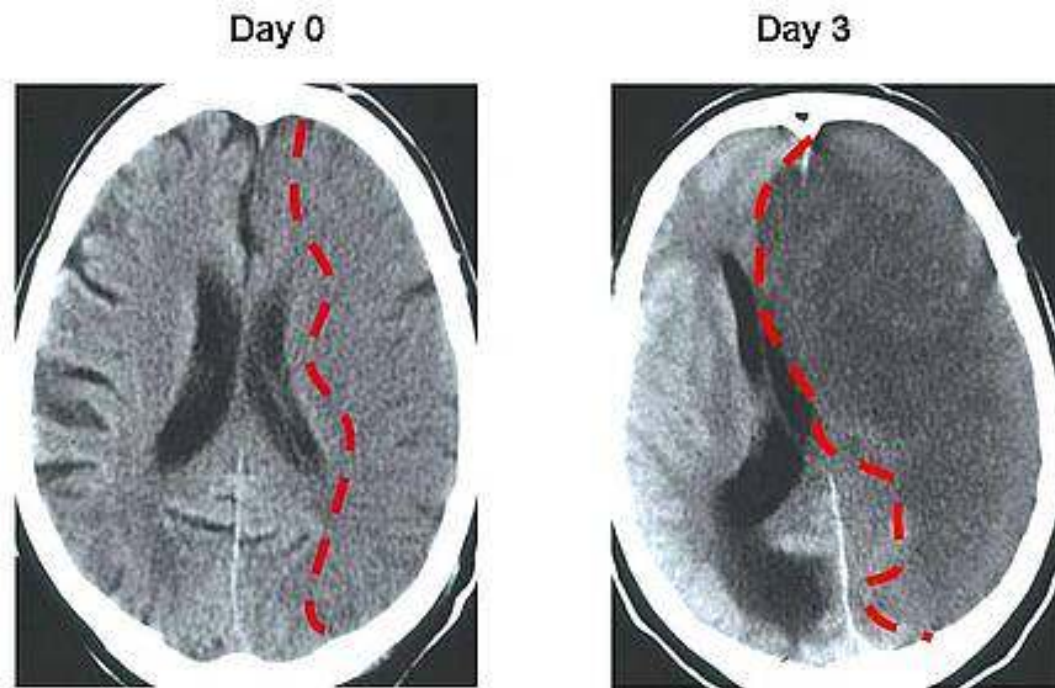
BP TARGET

- ⦿ No absolute target!
 - For patient not given thrombolytic, patient's clinical condition and neurological status should determine treatment rather than an arbitrary level of blood pressure. Usually anti-HT could be considered if BP >220/120mmHg.
- ⦿ BP must be lowered cautiously, usually with short acting anti-HTs.
- ⦿ For patient given thrombolytic, intensive BP monitoring and aim SBP <180, DBP <105

COMPLICATIONS OF ACUTE STROKE

- ◉ Haemorrhagic transformation
- ◉ Malignant MCA syndrome
- ◉ Hyperglycemia
- ◉ Fever
- ◉ Pulmonary complications e.g. pneumonia and abnormal breathing patterns
- ◉ Increased risk of hospital acquired infection

MALIGNANT MCA SYNDROME



- Cerebral edema and mass effect typically peaks on day 3-5
- Medical treatment Vs decompressive craniectomy

DENSE MCA SIGN & DOT SIGN



LOSS OF GREY WHITE DIFFERENTIATION EFFACEMENT OF SULCI



INTRA-ARTERIAL TPA

- ◉ Local thrombolytic can be delivered directly at the thrombus site at higher concentration with less systemic side effects
- ◉ Onset to needle time can be extended
- ◉ Procedural risk mainly ICH can be disastrous



37/F

- ◉ c/o progressive difficulty in walking
- ◉ History of flu like symptoms 2 weeks ago
- ◉ Admitted for shortness of breath and 4 limbs weakness
- ◉ Intubated for respiratory failure
- ◉ Examination found hypotonia, normal muscle bulk, absent tendon reflexes, weakness distal>proximal, parathesia over gloves and stocking areas
- ◉ NCT: demyelination
- ◉ Imp:

NEUROMUSCULAR RESPIRATORY FAILURE

◉ Localisation

- Central
- Peripheral

	Neuropathy	Myopathy	Myelopathy	NMJ disorder
Weakness	Distal > proximal	Proximal > distal	Below level of lesion	Fluctuating/ muscle fatigue
Deep tendon reflexes	Severe reduction/ early loss	Mild reduction/ late loss	Increased	Normal or mildly reduced
Sensory	Distal/ ascending	Preserved	Sensory level	Preserved

NEUROMUSCULAR RESPIRATORY FAILURE

- Progress may be insidious and unrecognized until sudden decompensation and respiratory arrest
- Meticulous monitoring of respiratory function (VC) is essential:
 - Guillain Barre Syndrome, Myasthenia Gravis, polymyositis etc
- Acute ventilatory failure
 - hypoventilation (diaphragm and intercostal muscle weakness)
 - inadequate airway protection (bulbar weakness)
 - poor secretion clearance
- Commonly used intubation threshold $VC < 15\text{ml/kg}$

GBS

- ◉ Most frequent cause of acute flaccid paralysis worldwide and is associated with most dramatic neurological deterioration
- ◉ Demyelinating polyneuropathy, immune mediated, 20-30% of cases in North America, Europa and Australia are preceded by *Campylobacter jejuni* infection
- ◉ Specific treatment: Ivlg or plasmapheresis
- ◉ 80% have good outcome at 1 year, 20% remaining disabled, ICU mortality ~5%. Prognosis worse in elderly and those required prolonged MV.

DIFFERENTIAL DIAGNOSIS OF GBS

Acute myelopathies e.g. cord compression

Neuromuscular disorder

- ◉ Myasthenia gravis
- ◉ Botulism, organophosphate poisoning

Muscle abnormalities

- ◉ Critical illness myopathy
- ◉ Metabolic cause: HypoK, hypoPO₄, hyperMg

Acute brainstem syndrome e.g. stroke

Viral infection

- ◉ Poliomyelitis, Paralytic rabies, Tick paralysis

MG

- ◉ NMJ disorder, autoimmune disease (Anti-AChR Ab, Anti-MuSK Ab)
- ◉ ~75% patients have ocular symptoms
 - Ptosis & diplopia, usually asymmetrical & bilateral
- ◉ ~10% patients have thymic tumor
- ◉ MG crisis commonly seen after stress
 - URI, infection, medication change, surgery, obstetrical delivery, high environmental temperature
- ◉ Specific treatment:
 - Ivlg or plasmapheresis
 - Mestinon
 - Steroid, other immunosuppressants
 - Thymectomy
- ◉ Excellent prognosis with modern treatment

SUPPORTIVE CARE IN ICU

- ◉ Autonomic instability
 - blood pressure change, cardiac arrhythmias
- ◉ Splints to prevent tendon shortening
- ◉ Adequate nutrition
- ◉ Chest physiotherapy, postural drainage and bronchial suctioning of secretion
- ◉ DVT prophalaxis
- ◉ Management of pain (can be severe in GBS) and constipation

59/M

- ◉ Good past health, non smoker non drinker
- ◉ Half marathon runner
- ◉ Collapsed in front of the finish line during the HK marathon
- ◉ CPR started immediately until arrival to AED, total downtime ~30mins
- ◉ Given therapeutic hypothermia for 24 hrs in ICU
- ◉ Remained in coma after 48 hrs
- ◉ Imp:

CONSIDERATIONS IN COMA

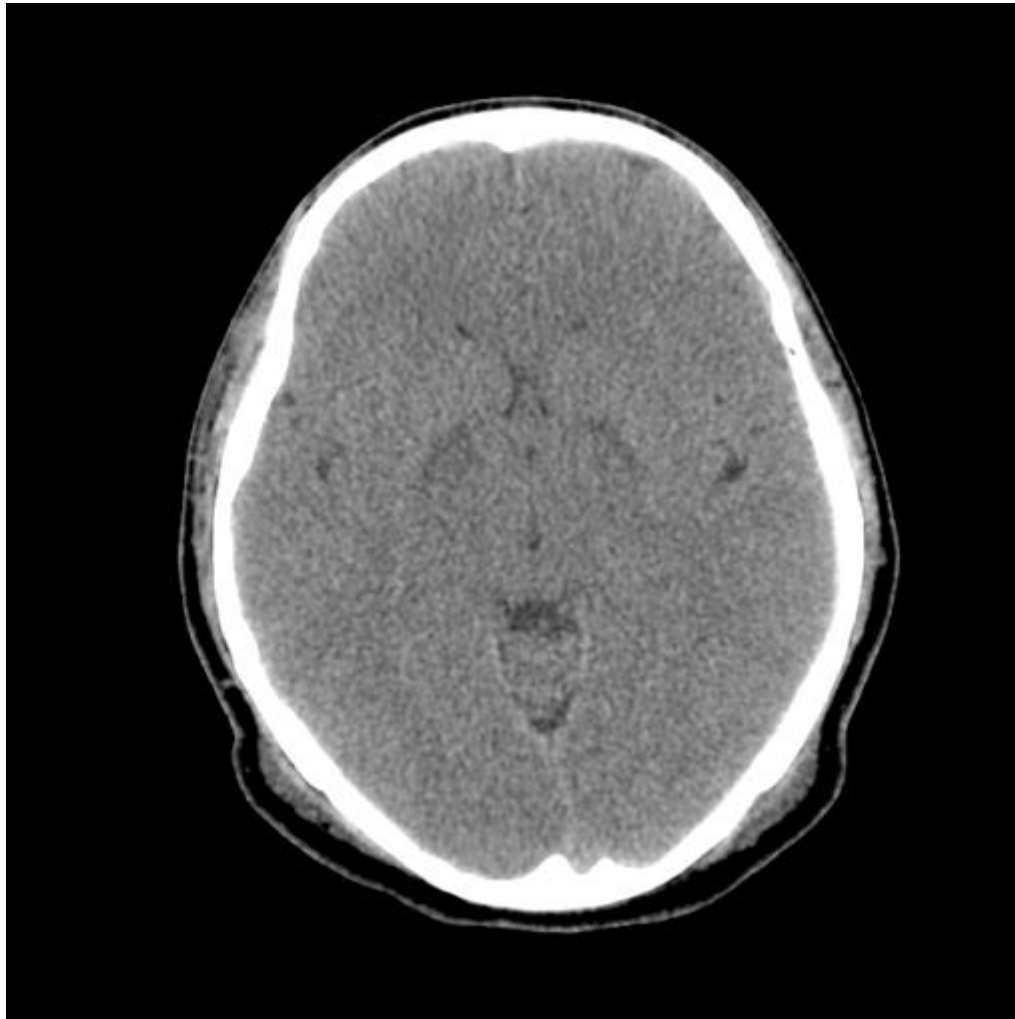
- ◉ Bilateral cortical or brainstem stroke
- ◉ Mass effect with acute lateral shift of the brain / herniation
 - Abscess
 - SDH, EDH, ICH
 - Tumor
- ◉ Trauma
- ◉ Increase ICP
- ◉ CNS infection

Structural

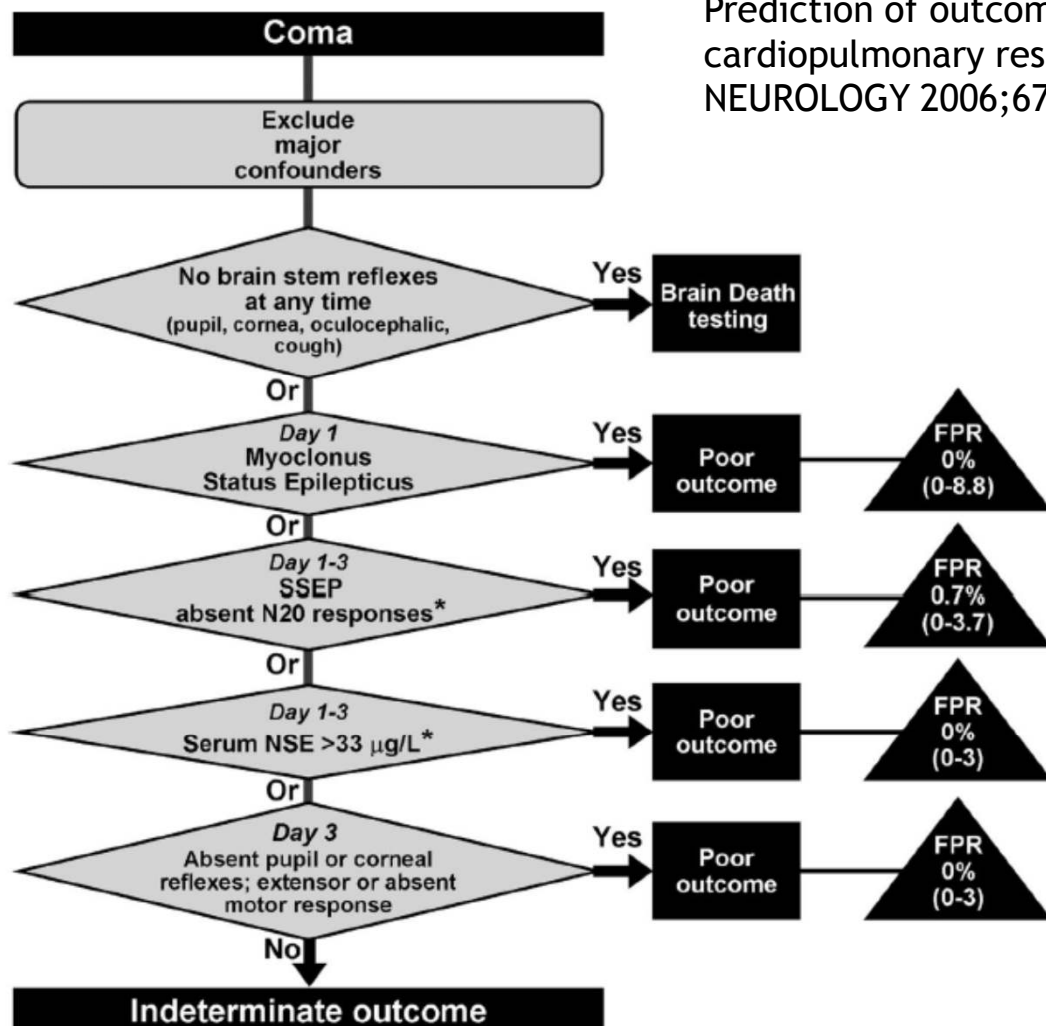
- ◉ Organs failure
- ◉ Electrolyte imbalance
- ◉ Sepsis
- ◉ Medications and DO
- ◉ Vitamin deficiency
- ◉ Status epilepticus
- ◉ Hypo/hyperthermia
- ◉ Endocrine
 - HypoG, DKA, HONK, Addison's, myxoedema
- ◉ Vascular
 - Hypertensive encephalopathy, TTP

Non-structural

SEVERE HYPOXIC ISCHEMIC ENCEPHALOPATHY



AMERICAN ACADEMY OF NEUROLOGY GUIDELINE



Prediction of outcome in comatose survivors after cardiopulmonary resuscitation
NEUROLOGY 2006;67:203-210

*Figure. Decision algorithm for use in prognostication of comatose survivors after cardiopulmonary resuscitation. The numbers in the triangles are percentages. The numbers in parentheses are exact 95% CIs. Major confounders could include the use or prior use of sedatives or neuromuscular blocking agents, induced hypothermia therapy, presence of organ failure (e.g., acute renal or liver failure) or shock (e.g., cardiogenic shock requiring inotropes). Studies in comatose patients after CPR have not systematically addressed the impact of these factors on the reliability of clinical neurologic examination and tests. Therefore, these confounding factors potentially could diminish the prognostic accuracy of this algorithm. *These test results may not be available on a timely basis. Serum NSE testing may not be sufficiently standardized.*

FRP: false positive rate
NSE: neuron specific enolase

- ◉ As a rule, the longer the coma persists, the less favorable the prognosis.
- ◉ When a poor outcome is anticipated, the need for life supportive care must be discussed.
- ◉ Communication with the relatives is very important. Several scheduled meeting with the family is generally required to facilitate a trusting relationship.

BRAINSTEM DEATH

- ◉ The concept that brainstem death is equivalent to death is accepted legally and within the medical community in Hong Kong.
- ◉ Diagnosis of severe brain injury consistent to progression of brainstem death must be established. There should be **no doubt** that the patient's condition is due to **irremediable structural** brain damage.
- ◉ Once brainstem death has occurred, artificial life support is inappropriate and should be withdrawn. It is good medical practice to recognize when brainstem death has occurred and to act accordingly, sparing relatives from further emotional trauma of futility.

DIAGNOSTIC CRITERIA

Preconditions prior to considering brainstem death test (age >2)

1. Diagnosis of severe brain injury consistent to progression of brainstem death must be established.
2. Apnoeic patient on a ventilator
 - The patient is unresponsive and not breathing spontaneously. Muscle relaxants (neuromuscular blocking agents) and other drugs should have been excluded.

PERIOD OF OBSERVATION AND REPETITION OF TESTS

- ◉ After a period of observation, the irreversibility of cessation of brainstem function is established. Two separate examinations should be performed by two medical practitioners.
- ◉ The first formal examination should only be performed after
 - All preconditions have been met
 - A **minimum of 4 hours observation** with a primary intracranial event such as severe head injury, spontaneous intracranial haemorrhage, or after neurosurgery that the condition is irremediable.
 - The minimum period of observation need to be extended to a total of **24 hours after cardiorespiratory arrest**.
- ◉ The second examination can be performed any time after the first examination.

DIAGNOSTIC CRITERIA

Exclusion of potentially reversible causes of coma

- ◉ Sedative drug effects are excluded
- ◉ Neuromuscular function is intact
- ◉ Body temp > 35C
- ◉ No severe electrolytes, metabolic and endocrine disturbances
- ◉ MAP > 60

CLINICAL TESTS OF BRAINSTEM FUNCTION

All of the followings must be passed

1. No pupillary responses to light and pupils $\geq 4\text{mm}$
2. No corneal reflexes
3. No eye movement on cold caloric test
4. No tracheal or gag reflexes
5. No motor responses in cranial nerve distribution to stimulation of face, limbs or trunk
6. No respiratory movement with arterial $\text{PaCO}_2 > 8\text{kPa}$ and $\text{pH} < 7.3$

CLINICAL TESTS OF BRAINSTEM FUNCTION

◉ Cold caloric test

- Inspect both tympanic membrane before test to r/o any local trauma
- Slow of at least 20ml of ice-cold water into at least one side or preferably into both sides in turn

◉ Apnea test

- To be done last
- Preoxygenation, give oxygen through a catheter to the trachea during the test
- Disconnect patient from ventilator for long enough (PaCO_2 is expected to rise at 0.27kPa/min)

CONFIRMATORY INVESTIGATIONS

- ◉ Can consider If the preconditions for clinical diagnosis and confirmation of brain death cannot be satisfied
 - No clear cause of coma
 - Possible metabolic or drug effect
 - Cranial nerves cannot be adequately tested
 - Cervical cord injury
 - Cardiovascular instability precluding apnea test
 - Severe hypoxaemic respiratory failure precluding apnea test

CONFIRMATORY INVESTIGATIONS

- ◉ Four vessel radio-contrast angiography by digital subtraction, may be used to demonstrate absent intracranial blood flow.
- ◉ Radionuclide examination which demonstrates absent brain perfusion can also be used. An agent which can cross the blood-brain barrier and be retained by brain parenchyma, either ^{99m}Tc -HMPAO ^{99m}Tc -ECD should be used.
- ◉ The four hour period of observation of coma and of absent brain stem responses, where these can be tested, should also apply and should precede the investigation.

BRAINSTEM DEATH OR NOT?

- ◉ Movements of limbs in response to a stimulus outside the distribution of cranial nerves
- ◉ Sweating, blushing, tachycardia
- ◉ Normal blood pressure
- ◉ Absence of diabetes insipidus
- ◉ Deep tendon reflexes
- ◉ Extensor plantar reflex

compatible

- ◉ Decerebrate posture
- ◉ Decorticate posture
- ◉ Seizures

incompatible



NO Brainstem death test!

COMMON NEUROLOGICAL PROBLEMS REQUIRING INTENSIVE CARE

- ◉ Acute delirium
- ◉ Status epilepticus
- ◉ Acute ischemic stroke
- ◉ Neurological respiratory failure
- ◉ Brain death



THE END