GUIDELINE REVIEW

EVIDENCE-BASED GUIDELINE FOR THE MANAGEMENT OF DECREASED CONSCIOUS LEVEL

ep115

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Arch Dis Child Educ Pract Ed 2006;**91**:ep115–ep122. doi: 10.1136/adc.2006.104471

Children presenting to hospital with decreased level of consciousness without a history of trauma can pose a diagnostic challenge given the wide variety of causes and the frequent lack of clues as to diagnosis. They can make significant demands on intensive and high dependency resources. A recent UK population based study found a 40% mortality associated with non-traumatic coma as defined by a Glasgow Coma Score (GCS) of 12 or less for at least six hours, with an estimated annual incidence of 30 per 100 000 children and 160 per 100 000 in the first year of life.[1]

An evidence-based problem-orientated guideline has been produced over the last two years to aid the clinician in the decision-making processes.[2] The guideline was funded by a grant from the National Reye's Syndrome Foundation following on from their workshop chaired by Dr Sue Hall in 2002. This information is freely available at www.nottingham.ac.uk/paediatric-guideline.

The guideline can be used on children presenting with a decreased conscious level (a GCS < 15/15 or responding only to voice, pain or not responding on the "AVPU" scale). The guideline does not apply to those with a known diagnosis with a management plan in situ, the newborn infant admitted to a neonatal intensive care unit, or the child with a learning disability whose usual GCS would be < 15.

The guideline focuses on the immediately identifiable and treatable causes of decreased conscious level. A core set of investigations has been developed, which should be neither costly nor excessive in the volume of blood required. The results of these tests are intended to identify all the treatable causes within the first hour of presentation and help diagnose the less common ones at a later stage if necessary. As the guideline tries to cover all the possible causes of decreased consciousness, some care pathways end with a reference to other guidelines available once the problem has been identified (for example, for diabetic ketoacidosis,[3] trauma,[4 5] and convulsions[6]).

As well as the algorithm reproduced here (parts I–VI), the guideline includes parent information leaflets, audit tools, guidance on implementation including a care pathway and a clinical Powerpoint presentation, and a detailed evaluation of the evidence underpinning the recommendations. There are also recommendations as to what to do if a child dies, including postmortem investigations to be undertaken.

KEY POINTS

- Request the "core investigations" as soon as a decision has been made to investigate the child's condition (grade D); see part I of algorithm.
- Think about all the possible causes of decreased consciousness concurrently not sequentially (grade D).
- Acute investigations and management of metabolic conditions (hypoglycaemia, hyperammonaemia and non-hyperglycaemic ketoacidosis); see parts II, IV and V of algorithm.
- The recognition and initial management of intracranial infections, with criteria for blind treatment (grades A to D); see parts II, III and V of algorithm.
- Contraindications to lumbar puncture (grade D); see part VI of algorithm.
- A normal computed tomographic (CT) scan does not exclude acutely raised intracranial pressure (grade A), and should not influence the decision to perform a lumbar puncture if other contraindications are present (grade D).
- In a child at any age, if the cause remains unknown after reviewing initial core investigations, start broad spectrum antibiotics and aciclovir (grade D); see part VI of algorithm.

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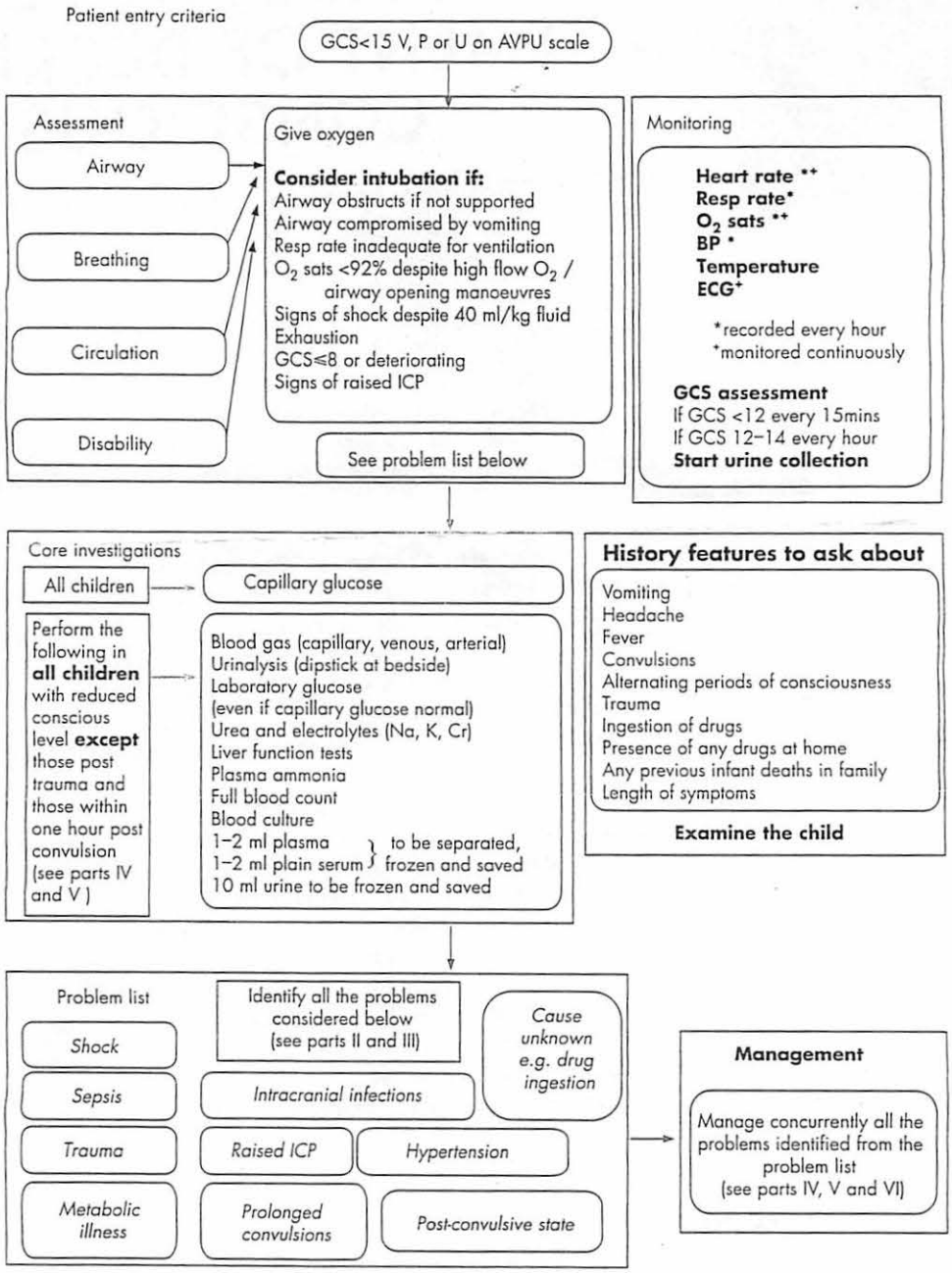
Algorithm for the management of a child aged 0–18 years with a decreased conscious level



Algorithm part I.

Identify all problems

Several suspected problems may co exist and need concurrent management. Identify if each problem is suspected and tick the box ☐. When all problems have been considered go to tables for tests and treatments (parts IV, V, and VI).

Shock☐ Go to table 1

Recognised clinically if reduced consciousness and **one or more** of the following:
- Capillary refill >2 seconds
- Mottled, cool extremities
- Diminished peripheral pulses
- Systolic BP < 5th centile for age
- Decreased urine output <1 ml/kg/hour

Sepsis☐ Go to table 2

Recognised clinically if reduced consciousness and two or more of the following 4:
- Temp >38°C or <36°C
- Tachycardia
- Tachypnoea
- White cell count <4000 cumm or >12 000 cumm

or

- A non-blanching rash (B)

Trauma ☐
Go to table 3

Recognised from history and examination findings

Metabolic illness
Diabetic ketoacidosis ☐
Go to table 4

Recognised if reduced consciousness and all of the following:
- Capillary glucose >11 mmol/l
- pH <7.3
- Ketones in urine

Metabolic illness
Hypoglycaemia ☐
Go to table 5

Recognised if reduced consciousness and capillary glucose <2.6 mmol/l (if capillary glucose 2.6–3.5 check glucose result from core investigations urgently)

Metabolic illness
hyperammonaemia ☐
Go to table 6

Recognised if plasma ammonia >200 mmol/l

Metabolic illness
Non-hyperglycaemic ketoacidosis ☐
Go to table 7

Recognised if reduced consciousness and pH <7.3 and ketones in urine without hyperglycaemia

Intracranial infection
Bacterial meningitis ☐
Go to table 8

Recognised clinically if neck stiffness/pain and total summed score is 8.5 or more using the following rule:

Symptom/sign	Score
GCS ≤8	= 8
Neck stiffness	= 7.5
Time of symptoms	= 1 per each 24 hrs
Vomiting	= 2
Cyanosis	= 6.5
Petechiae	= 4
Serum CRP	=(CRP in mg/l)/100

or

If no neck stiffness suspect bacterial meningitis if fever and two or more of the following 3:
- Rash
- Bulging fontanelle
- Irritability

Algorithm part II.

Intracranial infection
Herpes simplex encephalitis (HSE) ☐
Go to table 9

Recognised clinically if reduced consciousness and one or more of the following:
- Focal neurological signs
- Fluctuating GCS >6 hours
- The child has or has been in contact with herpetic lesions

Intracranial infection
Abscess ☐
Go to table 10

Recognised clinically if reduced conscious level and focal neurological signs +/– signs of infection and/or signs of raised ICP

Intracranial infection
TB meningitis ☐
Go to table 11

Recognised clinically if reduced consciousness and signs of meningitis and/or contact with pulmonary TB

Raised ICP ☐
Go to table 12

Recognised clinically if papilloedema or two or more of the following 5:
- Reduced consciousness (U on AVPU or GCS ≤8)
- Abnormal pattern of respiration
- Abnormal pupils
- Abnormal posture
- Abnormal doll's eye/caloric response

Hypertension ☐
Go to table 13

Recognised if systolic BP > 95th centile for age on two separate readings

Prolonged convulsion ☐
Go to table 14

Recognised clinically if convulsion lasts >10 minutes

Post-convulsive state ☐
Go to table 15

Recognised clinically if reduced conscious level within one hour post convulsion and a normal capillary glucose

Cause unknown ☐
go to table 16

No clinical clues to the cause after core investigations reviewed, consider drug ingestion, non-convulsive status, metabolic encephalopathy not presenting with hyperglycaemia/hypoglycaemia/hyperammonaemia/non-hyperglycaemic ketoacidosis, other infectious agents, inflammatory conditions–see table 16

Have you identified all the suspected problems?

Only move on to the tables for further tests and treatments (parts IV, V, and VI) when ALL PROBLEMS have been considered.

Algorithm part III.

Management of all 16 identified problems

Table 1 Shock

Investigations

Core investigations
and look for sepsis, trauma, anaphylaxis, heart failure

Treatment:

- Fluid bolus 20 ml/kg (colloid/crystalloid) (B) and assess response (good response = ↓ tachycardia, improved capillary refill time, ↑urine output, ↑GCS)
- Further fluid therapy guided by clinical response and >60 ml/kg may be required (B)
- If >40 ml/kg has been given consider intubation/ventilation and drugs for circulatory support

Table 2 Sepsis

Investigations

Core investigations and consider:
coagulation studies, chest X-ray, throat swab, lumbar puncture (if safe*), urine culture (if urinalysis+ve), PCR meningo–/pneumococcus, skin swab, joint aspiration, thick/thin film, intracranial imaging (if no source detected)

Treatment:

- Broad spectrum IV antibiotics after appropriate cultures have been taken
- Review by experienced paediatrician within 1 hour of admission

Table 3 Trauma

Investigations

Imaging appropriate to examination
Consider core investigations if medical collapse led to cause of trauma

Treatment:

- Follow ATLS guidelines

Table 4 Diabetic ketoacidosis (DKA)

Investigations

Core investigations

Treatment:

- Follow NICE guideline for DKA in children and young people

Table 5 Hypoglycaemia

Investigations

If **lab glucose** result from core investigations is <2.6 mmol/l then request following tests from saved samples:
plasma lactate, insulin, cortisol, growth hormone, free fatty acids, beta hydroxybutyrate, acyl-carnitine profile (on "Guthrie card" or saved frozen plasma) and urine organic acids

Treatment: If capillary or lab glucose <2.6 mmol/l

- After core investigations taken:
  - child >4 weeks old give 5 ml/kg IV 10% dextrose bolus
  - child ≤4 weeks old give 2 ml/kg IV 10% dextrose bolus
- Start IV infusion 10% dextrose to keep blood glucose between 4 and 7 mmol/l
- Seek advice from endocrinologist/metabolic specialist for further management

Table 6 Hyperammonaemia

Investigations

If ammonia result from core investigations is >200 µmol/l then request following from saved samples:
plasma amino acids, urine amino acids, urine organic acids, urine orotic acid and check coagulation studies

Treatment:

- Seek urgent advice from a metabolic specialist
- Start IV sodium benzoate (loading dose 250 mg/kg over 90 mins; followed by infusion 250 mg/kg over 24 hrs both diluted in 15 ml/kg 10% dextrose)
- If ammonia >500 µmol/l or is not improving and remains between 200–500 µmol/l after 6 hours of sodium benzoate therapy, consider emergency haemodialysis

*For acute contraindications and other details regarding lumbar punctures see table 17

Algorithm part IV.

Management of all 16 identified problems (continued)

Table 7 Non-hyperglycaemic ketoacidosis

Investigations

If pH <7.3, ketones in urine and a normal or low capillary glucose noted from core investigations then request following from saved samples:
plasma lactate, plasma amino acids, urine amino acids, urine organic acids

Treatment:

- Seek urgent advice from a metabolic specialist if child has non-hyperglycaemic ketoacidosis or plasma lactate >15 mmol/l
- Carefully monitor fluid balance due to risk of raised ICP
- Nutrition should be re-started early to prevent catabolism

Table 8 Bacterial meningitis

Investigations

Core investigations and lumbar puncture (if safe*)

Treatment:

- Give IV dexamethasone 0.15 mg/kg before/with antibiotics (A)
- Broad spectrum antibiotics (A) – don't delay if lumbar puncture contraindicated*

Table 9 Herpes simplex encephalitis (HSE)

Investigations

Core investigations and consider: MRI scan, EEG, lumbar puncture (if safe*) for HSV PCR (A)

Treatment:

- Give IV aciclovir 10 mg/kg (or 500 mg/m^2 if aged 3 months to 12 years) TDS (A) – don't delay if lumbar puncture contraindicated*
- Treatment should continue for 14 days if HSE highly suspected
- If no ongoing clinical suspicion of HSE aciclovir can be stopped before 14 days

Table 10 Intracranial abscess

Investigations

Core investigations and CT scan

Treatment:

- Broad spectrum antibiotics after blood cultures taken
- Seek urgent advice from a paediatric neurosurgeon

Table 11 TB meningitis

Investigations

Core investigations and lumbar puncture (if safe*) (B)

Treatment:

- If CSF microscopy is abnormal seek urgent advice from microbiology department

Table 12 Raised ICP

Investigations

Core investigations and consider CT scan (A)

Treatment:

- Position patient's head in midline
- Tilt patient head-up 20 degrees and avoid neck lines
- Maintenance fluids should not be hypotonic (B)
- Rate of maintenance fluids to be agreed locally
- Consider intubation and maintain $PaCO_2$ between 4.0–4.5 kPa
- Mannitol or 3% saline indications and dose to be agreed locally

Table 13 Hypertension

Investigations

Core investigations especially reviewing urinalysis, creatinine and urea, look for raised ICP, papilloedema, and check four limb BP

Treatment:

- Seek urgent advice from a paediatric nephrologist or intensivist

* For acute contraindications and other details regarding lumbar punctures see table 17

Algorithm part V.

Management of all 16 indentified problems (continued)

Table 14 Prolonged convulsion

Investigations
Core investigations if child not known to have epilepsy

If child under 12 months old request plasma calcium and magnesium (B)

Treatment:
- Follow APLS guidelines for anticonvulsant therapy
- If the convulsion is ongoing despite anticonvulsants, consider specific treatments for electrolyte imbalance, e.g.
- plasma sodium <115 mmol/l, give 5 ml/kg of 3% saline IV over one hour
- plasma calcium is <1.7 mmol/l or ionised calcium <0.75 mmol/l, give 0.3 ml/kg of 10% calcium gluconate IV over 5 mins
- plasma magnesium <0.65 mmol/l, give 50 mg/kg of magnesium sulphate IV over one hour

Table 15 Post convulsive state

Investigations
- It may be appropriate to closely observe the child if normal capillary glucose, without performing any further tests, in the first hour
- Detailed history and exam
  if still reduced GCS after one hour perform Core Investigations and investigations for "Cause unknown" (table 16)

Treatment:
- Treat according to history and examination findings
- If after 1 hour child has not recovered to their normal conscious level, treat as "Cause unknown" (table 16)

Table 16 Cause unknown

Investigations
Core investigations and if after reviewing these results the cause of reduced consciousness remains unknown request/perform the following: CT scan, lumbar puncture (if safe*), urine toxicology screen, urine organic and amino acids, plasma lactate.

If the cause is still unknown after reviewing Core investigations results, CT scan and initial CSF results, consider the following: EEG (?non-convulsive status); acyl-carnitine (on Guthrie card or from saved plasma); ESR and autoimmune screen (?cerebral vasculitis); thyroid function test and thyroid autoantibodies (?Hashimoto's encephalitis)

Treatment:
- Supportive treatments to protect airway, breathing and circulation
- Start broad spectrum antibiotics and IV aciclovir
- Discuss with paediatric neurologist within 6 hours of admission

*For acute contraindications and other details regarding lumbar punctures see table 17

Table 17 Lumbar puncture

A lumbar puncture should be deferred or not performed as part of the initial acute management in a child who has:

- GCS ≤8
- Deteriorating GCS
- Focal neurological signs
- Had a seizure lasting more than 10 mins and still has a GCS ≤12
- Abnormal breathing pattern
- Abnormal doll's eye response
- Abnormal posture
- Shock
- Bradycardia (heart rate <60)
- Hypertension (BP >95th centile for age)
- Clinical evidence of systemic meningococcal disease
- Pupillary dilatation (unilateral/bilateral)
- Pupillary reaction to light impaired or lost
- Signs of raised ICP

A normal CT scan does not exclude acutely raised ICP (A)
If a lumbar puncture is performed, CSF should be sent for microscopy (B), gram staining, culture and sensitivity, glucose (B), protein, PCR for HSE (B) and other viruses

Algorithm part VI.

COMMENTARY (BY JHB)

This clinical guideline addresses a relatively common presenting problem in paediatric clinical practice. It has been developed carefully using an appropriately robust methodology by a team already experienced in developing evidence-based guidelines. Where evidence was weak or lacking, a formal Delphi consensus process was used to arrive at recommendations. The methodology is well described, and includes the search strategy, definitions of the levels of evidence and derivation of grades of recommendation, and how the Delphi process was used.

The scope of the guideline is very broad, encompassing a large number of potential causes, with recommendations on diagnosis, initial investigations and management. This required a considerable number of separate literature searches. Many children will present severely ill, and the guidance therefore needs to be immediately accessible to front line medical staff seeing children "in the middle of the night". The algorithm accompanying this review is important in meeting this need. Although it provides a sufficient overview of the initial investigation and management of children presenting with impaired consciousness to assist immediate management, there are a number of additional recommendations that complement the algorithm, and these should be available to consult together with the algorithm.

Implementing the guideline will require time to educate front-line staff. The documentation provided should facilitate this. Local implementation will also mean ensuring that arrangements are in place for the emergency estimation of blood ammonia, and the occasional emergency availability of intravenous sodium benzoate. It will be imperative for local paediatric departments to implement these guidelines in collaboration with their local accident and emergency and intensive care services for children, as well as laboratory and pharmacy departments. Hopefully, by following the guideline more children will have their correct diagnosis recognised and treated more promptly. If so, the time and effort required for implementation will be well spent.

Only 20 of the 134 recommendations received an A or B grade recommendation (most of these are labelled in the algorithm), highlighting the relative lack of evidence found to support the guideline. Many recommendations, including the initial core investigations required, are based on the opinions of the Delphi panel. Until the guideline has been piloted, the consequences for the number of investigations performed and treatment given will not be clear. As the guideline states that it can be used in children presenting with a GCS of 14 or less, the range of diagnoses seen may differ from those in the UK population based study,[1] where children had a GCS of 12 or less for six hours. This raises the possibility that some children may be over-investigated and over-treated.

The guideline provides a list of contraindications to undertaking a lumbar puncture in children presenting with reduced consciousness. As this is largely based on expert opinion, its performance needs to be established in clinical practice. However, the guideline should help to avoid the emphasis sometimes placed on a normal CT scan in deciding whether the child should have a lumbar puncture. The Delphi panel did not reach consensus on one or two points, including whether to investigate children with a blood glucose between 2.6–3.5 mmol/l. These issues need to be resolved by local debate and consensus.

In summary, this guideline addresses an important and common clinical problem. It provides detailed evidence-based guidance on the initial investigation and management of children presenting with reduced consciousness. It links with a number of other diagnosis-specific guidelines.

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RPB and TJS, together with the Guideline Development Group, wrote the guideline including the algorithm.[2] JHB was not involved in the guideline development, contributed to the introduction to this review and wrote the commentary.

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