Guideline

Idiopathic intracranial hypertension (IIH) for children over five years

1 Scope

Trust-wide.

2 Purpose

- To ensure best practice in the diagnosis and management of idiopathic intracranial hypertension (pseudotumour cerebri).
- To help improve patient care.

3 Abbreviations used

- BMI: body mass index
- BP: blood pressure
- B-scan: brightness scan (ocular ultrasound)
- ICP: intracranial pressure
- CSF: cerebrospinal fluid
- CSFIS: CSF infusion study
- CT: computed tomography
- GA: general anaesthetic
- IH: intracranial hypertension
- IIH: idiopathic intracranial hypertension
- LP: lumbar puncture
- MDT: multidisciplinary team
- MRI: magnetic resonance imaging
- MRV: magnetic resonance venography
- OCP: oral contraceptive pill
- OCT: optical coherence tomography
- pCO₂: partial pressure of carbon dioxide
- SLE: slit-lamp examination
- USS: ultrasound scan

4 Introduction

Idiopathic intracranial hypertension is an uncommon but important cause of headache that can lead to visual loss. The purpose of the guideline is to aid medical and nursing staff to think about this as an important differential diagnosis when presented with a child with headache. This guideline helps the clinician to talk to parents about the management about this condition.
Idiopathic intracranial hypertension (IIH) is a syndrome characterised by:

- increased intracranial pressure in the absence of an intracranial mass or obstruction to CSF flow\(^1\)
- normal spinal fluid composition
- normal level of consciousness
- normal neurological examination except for papilloedema and occasional sixth nerve palsy
- normal imaging (CT and MRI) except widening of the optic sheath on thin orbital slices and narrowing of the lateral sinuses consistent with IIH on MRV

There is a wide clinical spectrum of this condition. Although IIH has been reported to occur in the absence of papilloedema, this should only happen after expert (see below) MDT review.

## 5 Causes/associations

### Obesity

The below may cause secondary IH:

- hypervitaminosis A
- inflammatory processes:
  - mastoiditis
  - SLE
  - sarcoidosis
  - Guillain-Barre syndrome
- drugs
  - tetracycline
  - sodium valproate
  - doxycycline
  - isoretinoin
  - nitrofurantoin
  - OCP
  - corticosteroid treatment/withdrawal
  - nalidixic acid
  - thyroid replacement
  - growth hormone
  - vasopressin
  - phenytoin
  - indomethacin
  - cyclosporin
- endocrine abnormalities
  - hypothyroidism
  - hyperthyroidism
  - thyroid replacement
  - chronic hypocalcaemia secondary to vitamin D deficiency
  - hypoparathyroidism
Paediatric neurology
Division E

- adrenal insufficiency
- hyperadrenalism
  - venous sinus thrombosis / narrowing
  - head trauma
  - protein malnutrition
  - iron deficiency anaemia
  - leukaemia
  - hypercoagulable states
  - polycystic ovary syndrome

6 Symptoms

Symptoms are those of increased intracranial pressure – headaches, nausea/vomiting and visual disturbances.

Headaches which are ‘novel’ in nature are predominantly frontal in location, become worse on lying down, and may wake the child at night. The headache may also occur daily lasting for a few days, unlike migraine which tends to last for a few hours, then remit to represent a few days later (ie intermittent nature).

Visual symptoms are:
- diplopia
- visual obscuration
- transient visual loss
- blurring of vision
- photophobia
- ‘shimmering of lights with coloured centres’

Other symptoms include:
- lethargy
- neck pain
- tiredness
- dizziness
- mood change
- intracranial buzzing sounds (pulsatile tinnitus)
- sleep and behaviour changes

7 Signs
7.1 Neurological examination

The examination is normal except for possible papilloedema, sixth nerve palsy, reduced visual acuity and visual field defects. Patients rarely present with a relative afferent pupillary defect. Sixth nerve palsy is the most common neurological abnormality reported in 9-48% of children with IIH.\(^3\)

Papilloedema needs to be confirmed by a paediatric ophthalmologist with expertise in the investigation of IIH. Assessment of visual acuity, colour
vision and visual fields (Kidzeyez) should be performed. Visual field loss or decreased visual acuity has been reported in 13-27%. This may be visible at presentation, progress during treatment or recur later in the course of the disorder. The papilloedema could be bilateral, asymmetrical or rarely unilateral. Optic nerve drusen may be mistaken for papilloedema but can be distinguished by ocular ultrasonography or CT (must be performed). Perimetry may reveal enlargement of the blind spot apart from visual field defects such as central scotomas or inferior nasal field defects.

Other rare neurological abnormalities reported have been:
- III or IV nerve paresis
- facial paresis neck pain
- seizures
- hyperreflexia
- bruit
- hypoglossal nerve palsy
- nystagmus
- choreiform movements

When these occur it is mandatory that other diagnoses such as an intracranial mass lesion is ruled out by the expert IIH MDT before a diagnosis is made.

The level of consciousness and intellectual function remain normal in contrast to a child with intracranial mass lesion.

### 7.2 General examination

- BP measurement.
- Height and weight measurements, calculation of the BMI and plot onto BMI chart.
- Ear, nose and throat examination for signs of:
  - otitis media
  - sinusitis
  - mastoiditis
- Signs of medical conditions which can cause secondary intracranial hypertension, in particular endocrinopathy.

### 8 Diagnosis

The diagnosis is one of exclusion. The initial diagnostic tests should include blood tests, neuroimaging and CSF pressure monitoring.

### 8.1 Blood tests

Blood tests are vital to exclude secondary causes of intracranial hypertension. As a minimum, the following blood tests should be performed:
- full blood count
- ferritin
- urea and electrolytes
- bone function tests
8.2 Neuroimaging

Where an intracranial mass or obstructive hydrocephalus is suspected a CT scan head with contrast needs to performed within 24 hours (look for drusen) unless an MRI scan can be performed within the same period (and is likely to produce good images considering the child’s developmental age). The main role of urgent MRI is to exclude space occupying lesions and ventriculomegaly.

Brain MRI is indicated in all patients suspected to have IIH and should be done with thin orbital slices for more detailed images, and to detect hydrops of the optic nerve sheath/ enlargement of the pituitary sella/ flattening of the posterior aspect of the globe/ papilloedema. These features lack sensitivity and selectivity but raise the suspicion of IIH if found together. Furthermore, a prospective blinded study demonstrated that the optic nerve sheath is significantly larger in children with IIH than in controls. Usually, normal sized ventricles are found. Small and even slightly dilated ventricles have been reported.

MRV is the investigation of choice to detect dural venous sinus thrombosis. It is important to rule out venous sinus thrombosis as a cause of IIH as steroid treatment in this case may exacerbate the condition. Venous sinus thrombosis may be because of a hypercoagulable state or secondary to mastoiditis/ middle ear infection which will also require treatment – medical/ surgical. MRV can have ‘typical’ narrowing of the lateral sinuses in conjunction with raised ICP.

8.3 CSF pressure monitoring

This needs to be undertaken only after the above investigations. Because of the dynamic nature of the CSF, instant CSF pressure measurement using the height of a fluid column via a lumbar puncture may be misleading.

The normal ICP depends on age, posture and clinical condition of the child. Most reviews consider a steady state value below 15mmHg (=20cm of H2O) in children over seven years as normal. Values above 20mmHg (=27cm of H2O) represent high pressure.

CSF pressure monitoring can give information about cerebral perfusion pressure and regulation of cerebral blood flow and volume. A local anaesthetic is used when measuring CSF opening pressures/ steady state pressures. Local anaesthetic and nitrous oxide sedative is recommended during the needle insertion. GA should be avoided when possible as it can raise ICP by 5-10mmHg. When GA is required, it is important to record an
end-tidal pCO₂. The CSF pressure monitoring needs to be done for at least 20 minutes, during which time the needle is connected to an electronic pressure transducer. The procedure is done in a lateral decubitus position with the child partially unflexed. A play specialist reduces the child’s anxiety. Before performing this study, acetazolamide must be stopped for at least 48 (preferably 72) hours.

Pressure should be lowered to 15-20cm H₂O during the first diagnostic LP.

8.4 CSF infusion studies

It is recommended that a CSF infusion study (CSFIS) is performed in children when the steady state pressure is under 30mmHg (=40cmH₂O). CSFIS are particularly useful when the pressure value is borderline (ie 15-19mmHg), or in the absence of papilloedema. A CSFIS involves pressure assessment during infusion of Ringer’s lactate, using a syringe with a pump connected to a second needle, until a steady state ICP plateau is achieved, then stopping infusion and measuring the pressure reduced.

Please look at checklist for the contact number of the person to contact for CSFIS.

9 Management

(Grade IV evidence obtained from expert committee reports or opinions and/or experience of respected authorities)

There are no randomized double blinded prospective studies of treatment. The natural history of the untreated condition is not known. The treatment modalities in the acute setting are as follows.

9.1 Medical treatment

9.1.1 Acetazolamide

Acetazolamide is the first line medical treatment for IIH. It acts as a carbonic anhydrase inhibitor.

**Dose (By mouth using immediate-release medicines, or by slow intravenous injection):**

Child 1 month to 12 years: 8mg/kg 8 hourly increased until clinical response as necessary to maximum dose of 32mg/kg 8 hourly (until headache resolves unless side effects* occur)

Immediate release tablets can be crushed and dispersed in water prior to administration. Follow Acetazolamide paediatric IV monograph for IV administration.
Example
- Week 1  10mg/kg tds
- Week 2  20mg/kg tds
- Week 4  25mg/kg tds
- Week 5  30-32mg/kg tds

Correct acidosis (bicarbonate <16 and symptomatic) with sodium bicarbonate (refer to the paediatric IV monograph for dosing). If bicarbonate >16 and asymptomatic no need to treat routinely.

Contraindicated
- history of sulphonamide hypersensitivity
- adrenocortical insufficiency
- hyperchoaemic acidosis
- hypokalaemia
- hyponatraemia
- long-term administration in patients with chronic non-congestive angle-closure glaucoma.

*Side effects
Common or very common:
Ataxia; depression; diarrhoea; dizziness; excitement; fatigue; flushing; headache; irritability; loss of appetite; nausea; paraesthesia; polyuria; taste disturbance; thirst; vomiting

Uncommon:
Blood disorders; bone marrow suppression; confusion; crystalluria; drowsiness; electrolyte disturbances on long-term therapy; fever; glycosuria; haematuria; hearing disturbances; melaena; metabolic acidosis; rash; renal calculi; renal colic; renal failure; renal lesions; Stevens-Johnson syndrome; toxic epidermal necrosis; ureteric colic

Rare:
Cholestatic jaundice; convulsions; flaccid paralysis; fulminant hepatic necrosis; hepatitis; photosensitivity

Monitor
- Electrolytes and bicarbonate – check weekly after starting/ increasing dosage. Once stable after one month and then 3-6 monthly.
- Monitor blood count: As a sulphonamide derivative, blood disorders, rashes, and other sulphonamide-related side-effects occur occasionally when used as long-therapy: patients should be told to report any unusual skin rash.

The length of treatment varies and can last 9-14 months. Weaning should be considered as soon as improvement is evident.\[^{3,27}\]

9.1.2 Topiramate

Topiramate is the second line agent for the treatment of IIH. It acts as a weak carbonic anhydrase inhibitor and may help in obese children as it as an appetite suppressant.
**Dose**
Start with 25mg at night and increase by 25mg weekly. Maximum dose of topiramate is typically 100-150mg daily.\textsuperscript{[12]}

**Side effects**
- word finding difficulties
- psychomotor slowing
- anorexia/ weight loss
- impaired concentration
- sedation\textsuperscript{[12]} Doses over 7mg/kg/day may cause unacceptable drowsiness.

9.1.3 **Furosemide and Bumetanide**
Usually reserved as a second line agent due to potential electrolyte disturbances.

9.1.4 **Steroids**
The evidence to use steroids is poor. All cases to be discussed within the expert IIH MDT and with the consultants. Chronic use is not advisable.

9.1.5 **Weight reduction**
Has been shown to improve symptoms in adults.\textsuperscript{[16]} All obese children refer to dietitian and obesity service.

9.2 **Surgical treatment**
Serial lumbar punctures, CSF shunting, subtemporal decompression, venous sinus stenting and optic nerve sheath fenestration are other options. These will be considered by the expert IIH MDT.

9.3 **Ophthalmic surveillance**
This should be arranged very soon after diagnosis and should continue until resolution.

9.4 **Secondary optic atrophy**
Secondary optic atrophy can occur within weeks of the development of severe papilloedema. Close, regular surveillance of the optic nerve function by a paediatric neuro-ophthalmologist is mandatory. The signs of optic nerve dysfunction include:
- reduction in visual acuity
- reduced contrast sensitivity
- impaired colour vision
- rarely relative afferent papillary defect (if asymmetrical)
9.5 Amblyopia

Children less than seven years of age are also at risk of developing amblyopia due to the development of a convergent squint secondary to the VI nerve palsy: occlusion therapy or prismatic glasses may be prescribed by the orthoptist or ophthalmologist to prevent the development of amblyopia.

Children over seven years of age are unlikely to develop strabismic amblyopia but will complain of diplopia – these children can be managed by occluding one eye (alternating the eye to be patched each day). This can be started before ophthalmic examination if the symptoms are severe.

10 Monitoring compliance with and the effectiveness of this document

1. High resolution MRI/MRV done in all cases with papilloedema at expert review.
2. Steady state CSF pressure study performed in those with papilloedema.
3. Expert (in all) and then regular ophthalmology review in those with papilloedema.
4. Medical follow up within two weeks of CSF pressure studies.

11 References


15. BNF for children


### 12 Associated documents

- CSF infusion study request form

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<table>
<thead>
<tr>
<th>Approval:</th>
<th>11 August 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owning department:</td>
<td>Paediatric neurology</td>
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</tr>
<tr>
<td>File name:</td>
<td>IIH guideline Version 2 August 2017.doc</td>
</tr>
<tr>
<td>Supersedes:</td>
<td>Version 1, July 2014</td>
</tr>
<tr>
<td>Version number:</td>
<td>2</td>
</tr>
<tr>
<td>Review date:</td>
<td>August 2020</td>
</tr>
<tr>
<td>Local reference:</td>
<td>Document ID: 33836</td>
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Appendix 1: IIH investigation algorithm for children over five

1. * MRI/MRV done within one week of detecting papilloedema.
2. If child presents to ophthalmology clinic, contact the on call paediatric neurologist to arrange review and imaging.
3. If Grade 4 papilloedema, and child unwell if urgent infusion study cannot be performed LP opening pressure to be done.
Appendix 2: checklists

I Ophthalmology review check list

1. Email/ telephone Ms Muthusamy/ Ms. Allen for urgent reviews.
2. Ensure that B-scan USS/OCT results available.
3. Check if there is drusen or papilloedema confirmed.
4. Check severity of papilloedema:
   - grade 3-4 papilloedema may need urgent LP to relieve pressure
   - grade 1-2 can be managed after the infusion study results are available

II Lumbar infusion study checklist

1. CT scan, MRI and MRV to be normal (except signs indicative of IIH) before the infusion study.
2. CSF studies to be done within two weeks of performing MRI/MRV.
3. Contact the CSF pressure assessment team (extension 8431764) who carries out the infusion study to arrange a date and time. Neurosurgical nurse specialists Eva Nabbanja/ Sam Oswold may be contacted to help co-ordinate the CSF infusion study with Zofia.
4. Request form (on ward D2) signed by Mr Garnett, Consultant Paediatric Neurosurgeon via his secretary or the on-call neurosurgical SpR (on-call neurosurgeon if MG on leave).
5. Use the help of the play therapist and nitrous oxide (available on ward D2) and local anaesthetic.
7. Consent form for the LP using nitrous oxide to be completed.
8. LP is usually done on ward D2.
9. The lumbar infusion study ideally requires 2 LP needle to be inserted in separate intervertebral spaces – so inform parents about this. 10ml of normal saline is injected into one of the spinal needles and recordings are done on a computer. The study takes about 30 minutes to complete. If the pressure is above 25mmHg then 5ml of CSF can be removed to decrease the CSF pressure to 20.
10. Advise to lie flat at least for 4-6 hours after the LP (avoids the headache getting worse), giving simple analgesia as needed.

III Lumbar infusion request form

IV Lumbar puncture patient information leaflet 1 (8-10 year old) and 2 (11 years above)
**V- Headache proforma**

**Response to therapy**
If there are headaches, these should improve within four days of starting acetazolamide; they may take two weeks to go completely.

**Ophthalmology follow up**
To be arranged and recommended by expert paediatric ophthalmologists, but neurology team to confirm arrangements with families.

The ophthalmologist will need a named consultant to discuss the results of the assessment/ review therapy.

The papilloedema/ visual function should be no worse at four weeks, but may not have improved. If there is deterioration then management will need to be discussed with a paediatric neurologist immediately.

At eight week assessment following the therapy, the papilloedema should have improved. If not, management will need to be discussed with a paediatric neurologist immediately.

On the assumption acetazolamide is tolerated, it would be continued for six months in the first instance. During this time aetiological factors such as drugs and obesity should be addressed. Trial withdrawal should be accompanied by monthly eye review. There must be urgent paediatric reassessment should symptoms such as a headache return.