Update on Pediatric Idiopathic Intracranial Hypertension

Bresnan Course
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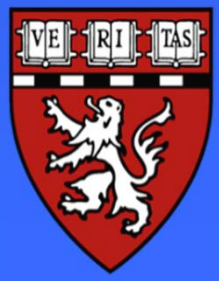


Disclosures

- I have no relevant financial or commercial disclosures.

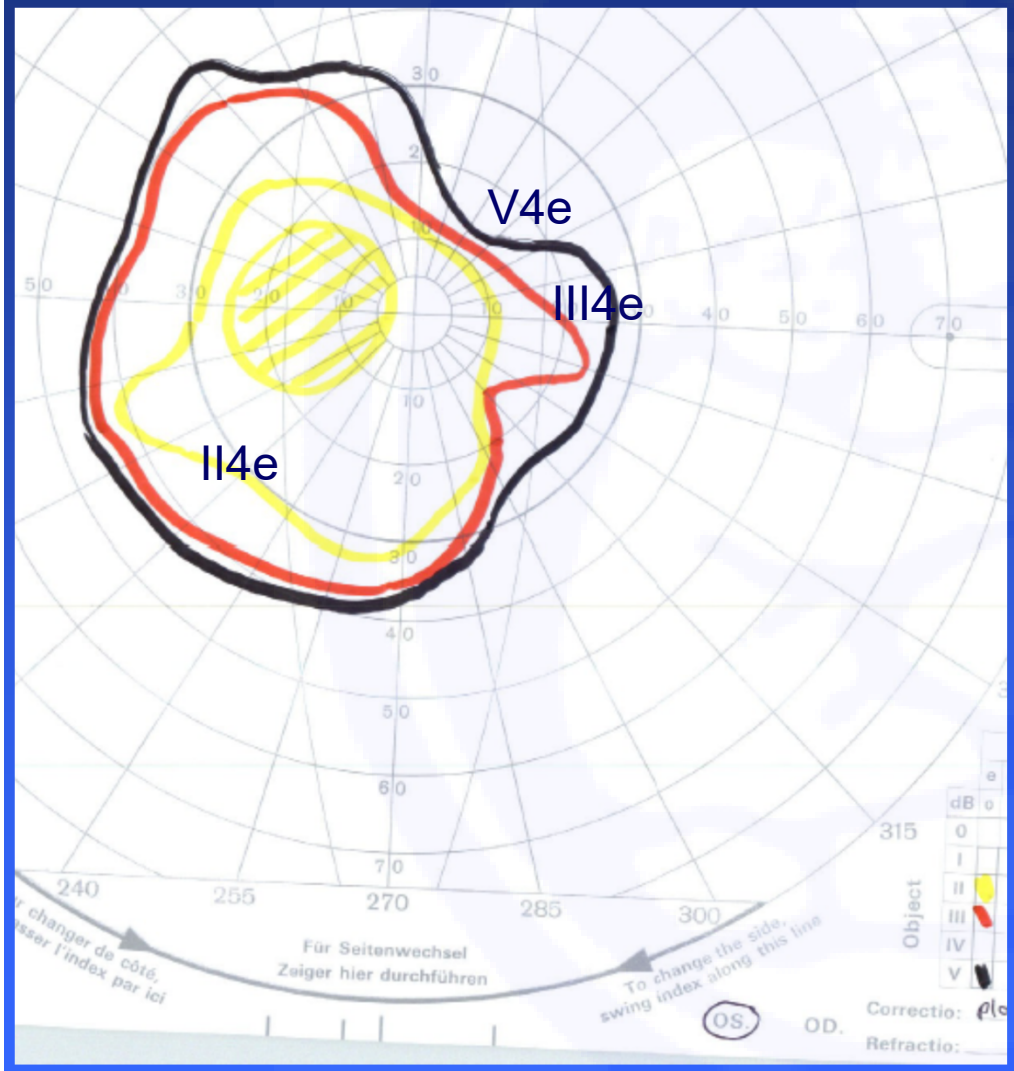
Case 1

A 13 year old boy presented to the Boston Children's Hospital Emergency Room with 3 weeks of headaches and 1 week of double vision.

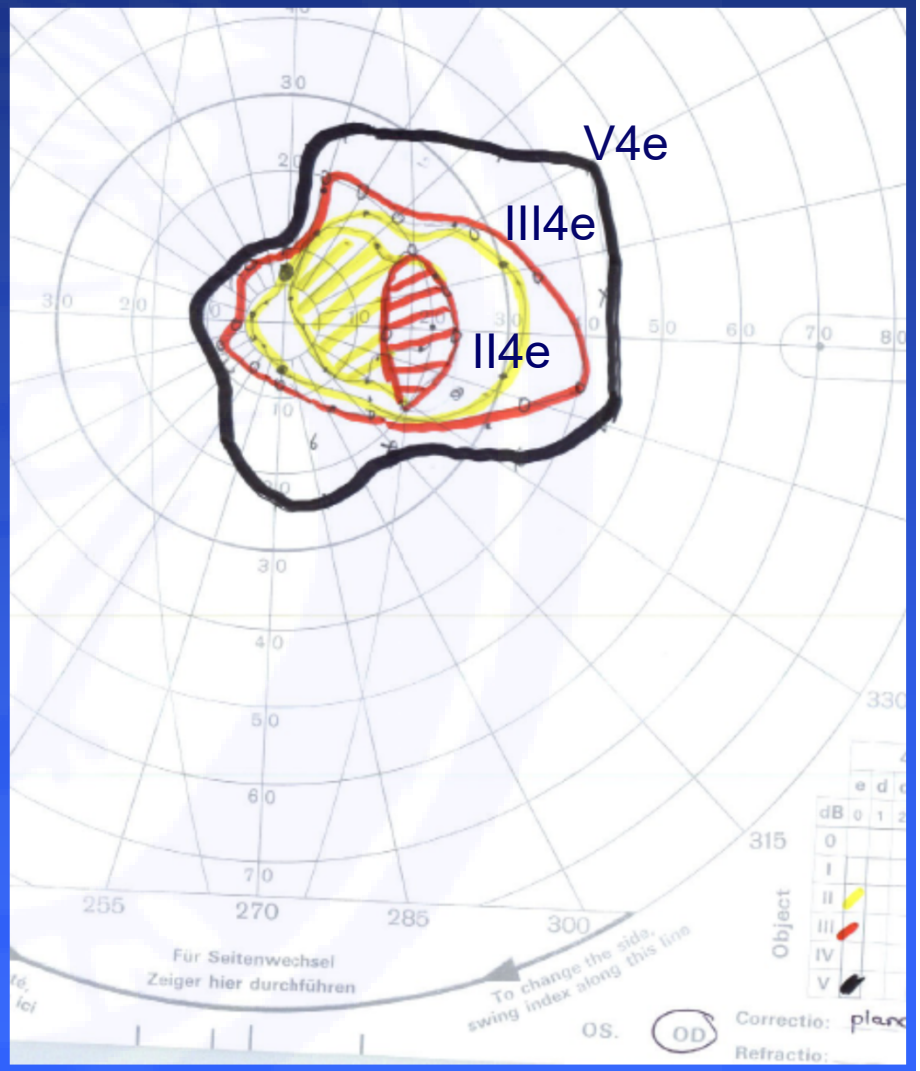
Examination

	Right Eye	Left Eye
Best corrected Visual acuity	20/200	20/80
Pupils	Normal, no relative afferent pupillary defect	
Color	Dyschromatopsia OD Normal OS	
Sensorimotor	Right 6th nerve palsy	

Goldmann Visual Fields

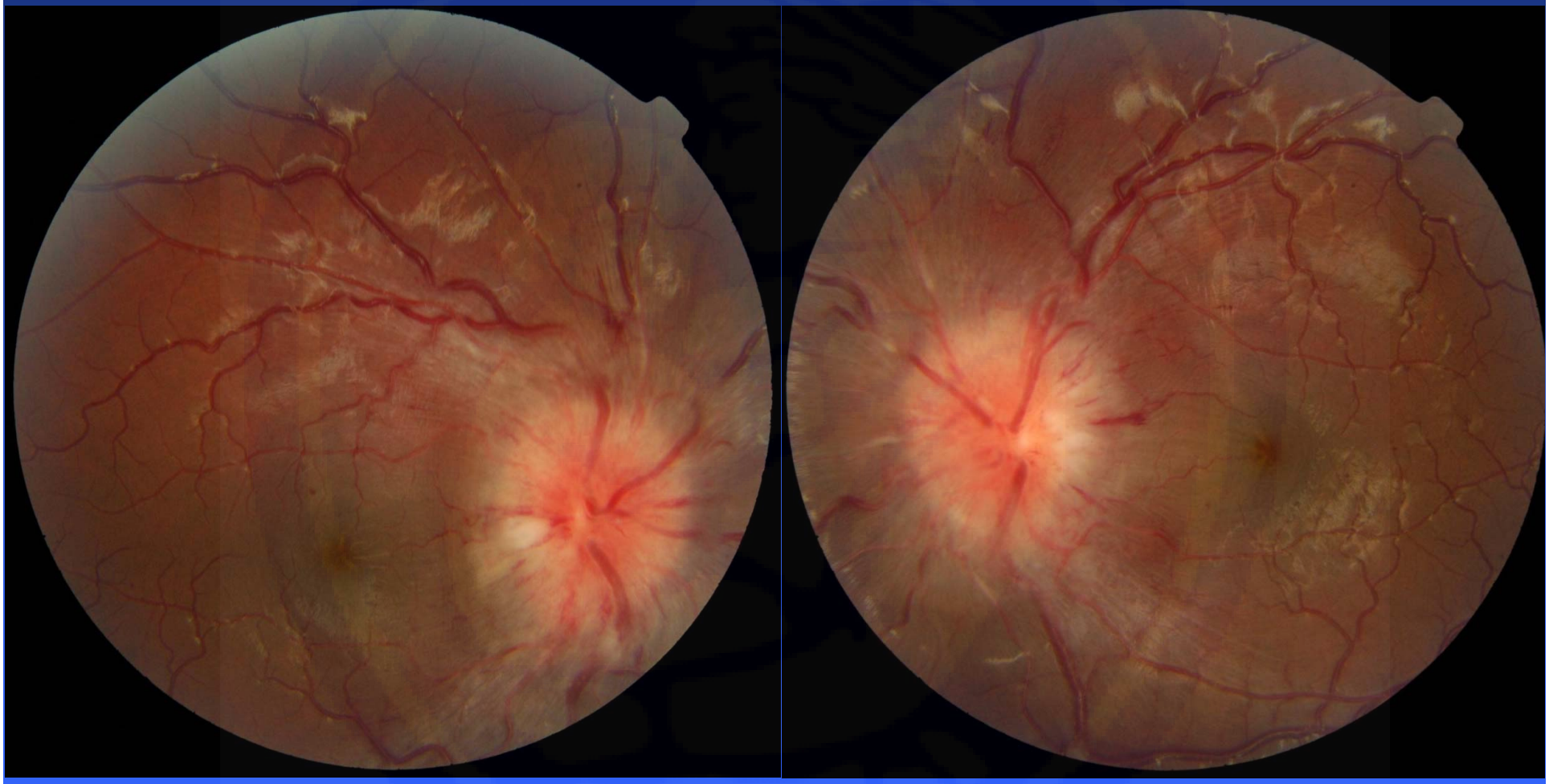


OS



OD

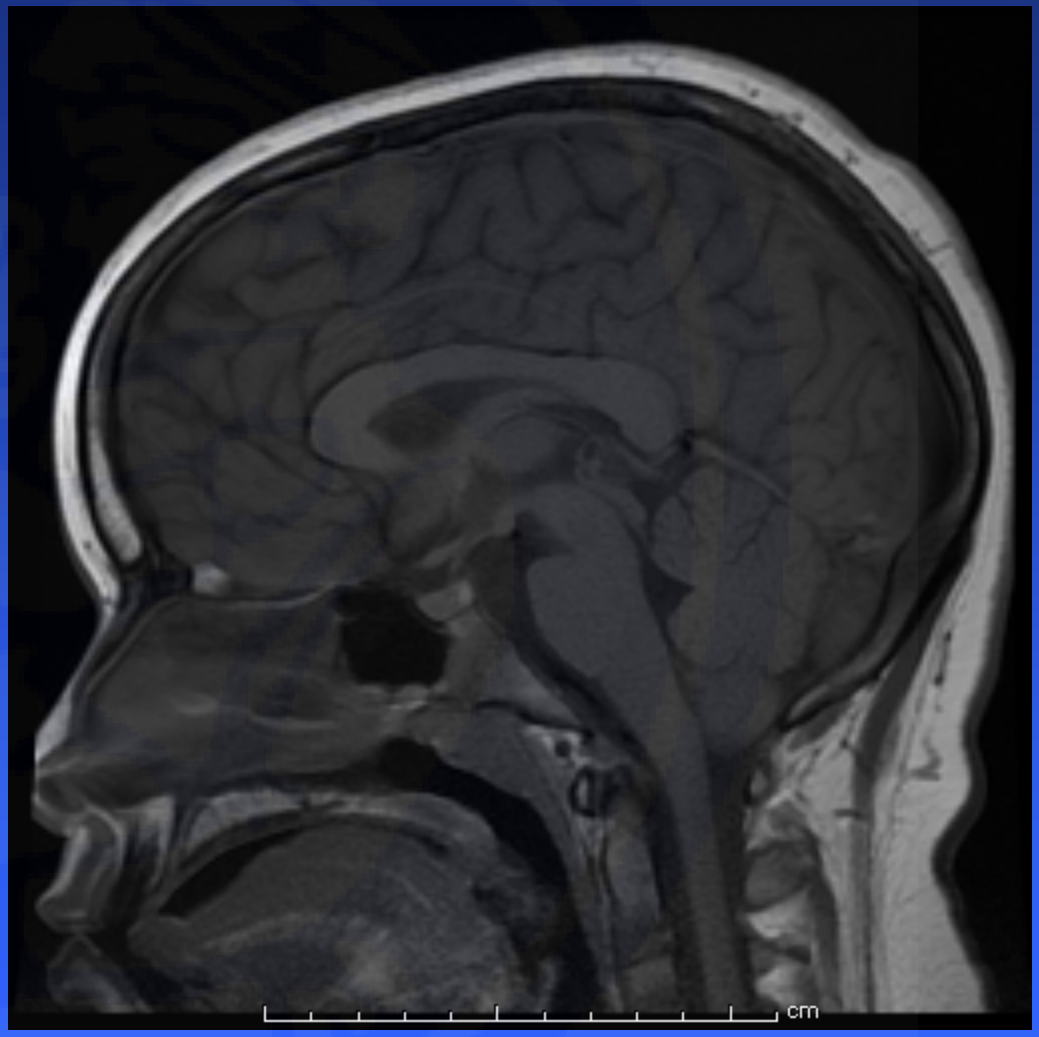
Fundus Photos at Presentation



OD OS

MRI brain: T1 Sagittal

- Normal MRI brain
- Slightly low lying cerebellar tonsils (4 mm) with normal configuration
- Normal MRV
- Lumbar puncture showed opening pressure of 55 cm H20 with normal CSF.



Diagnosis

Idiopathic intracranial hypertension

Treatment

- Started on diamox at 250 mg BID increased quickly to 750 mg BID.

- There was minimal improvement in his visual fields and acuity OD with a new relative afferent pupillary defect OD.

- He was sent for neurosurgical consultation regarding placement of a shunt and considered to be a poor candidate given his low lying cerebellar tonsils.

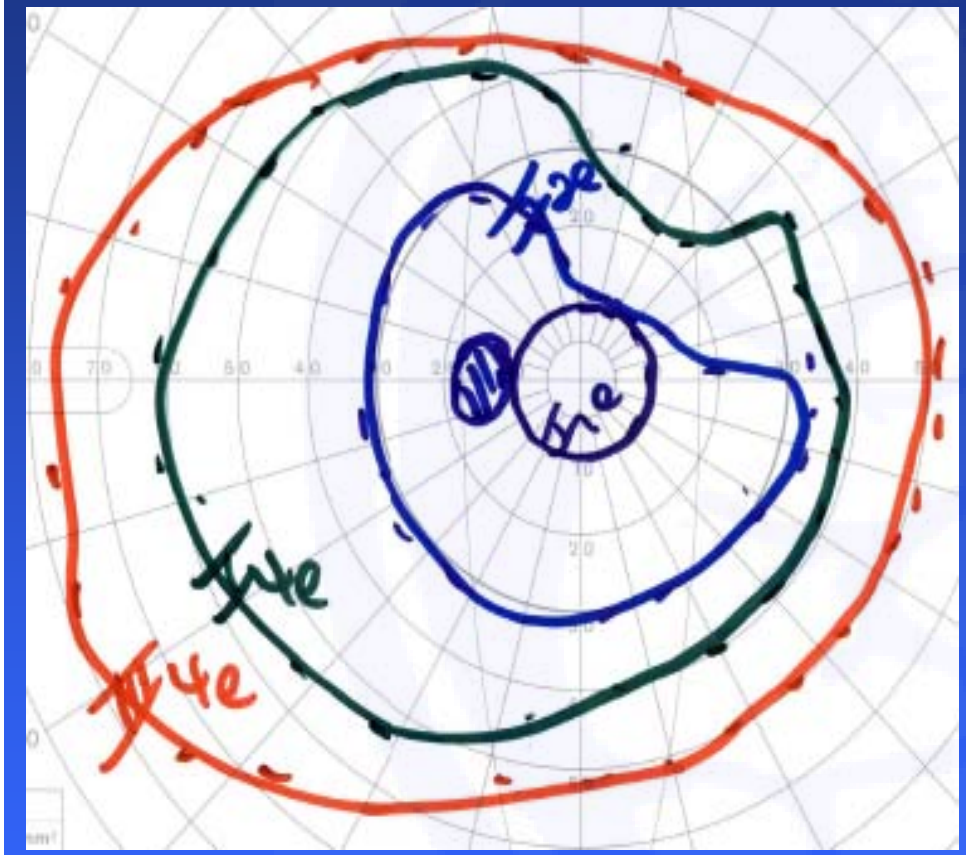
- A decision was made to perform an optic nerve sheath fenestration right eye 9 days following initial presentation.

Examination

4 month follow up

	Right Eye	Left Eye
Best corrected Visual acuity	20/25	20/20
Pupils	Relative afferent pupillary defect OD	
Color	Normal OD Normal OS	

Goldmann Visual Fields



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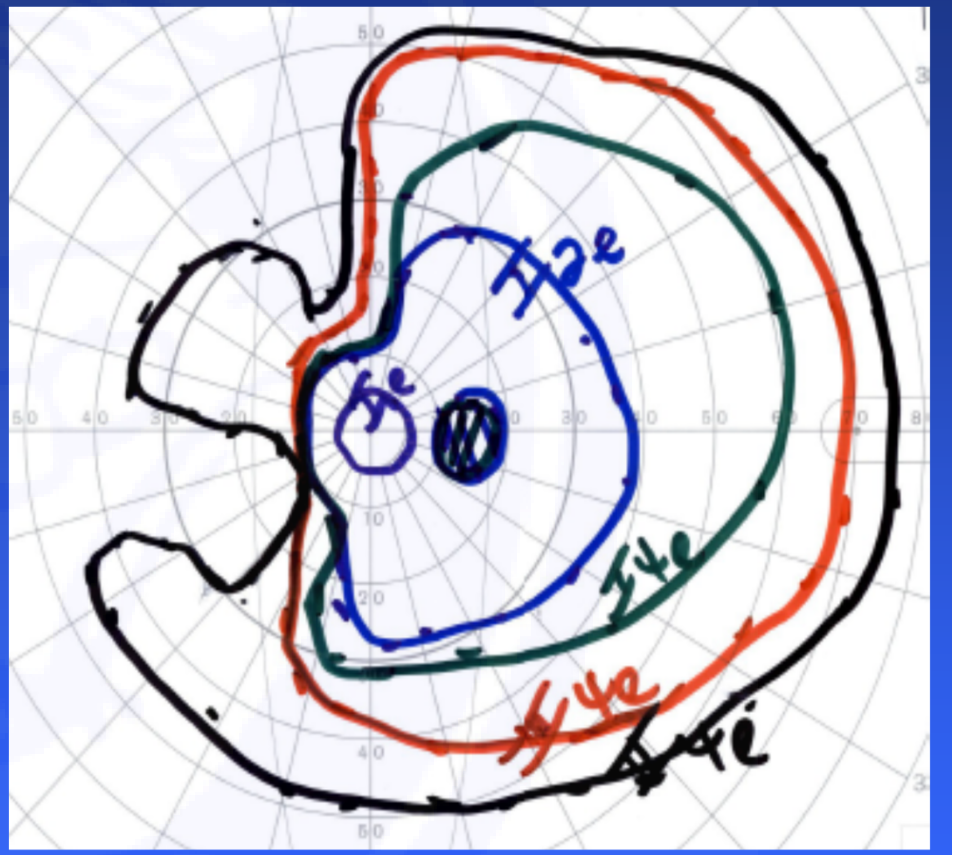


OD

Fundus Photos at Follow up

OD OS

Pediatric Idiopathic Intracranial Hypertension

- Is pediatric IIH distinct from adult IIH?
- What are the current diagnostic criteria for pediatric IIH?
- What are management options?
- What are long-term outcomes in pediatric patients?
- How may we improve treatment?

Epidemiology

- In adults, incidence of 0.9 in 100,000 in general population and 19.3 in 100,000 in obese women age 20-44 (Durcan, Corbett, Wall. Arch Neurol 1988.)

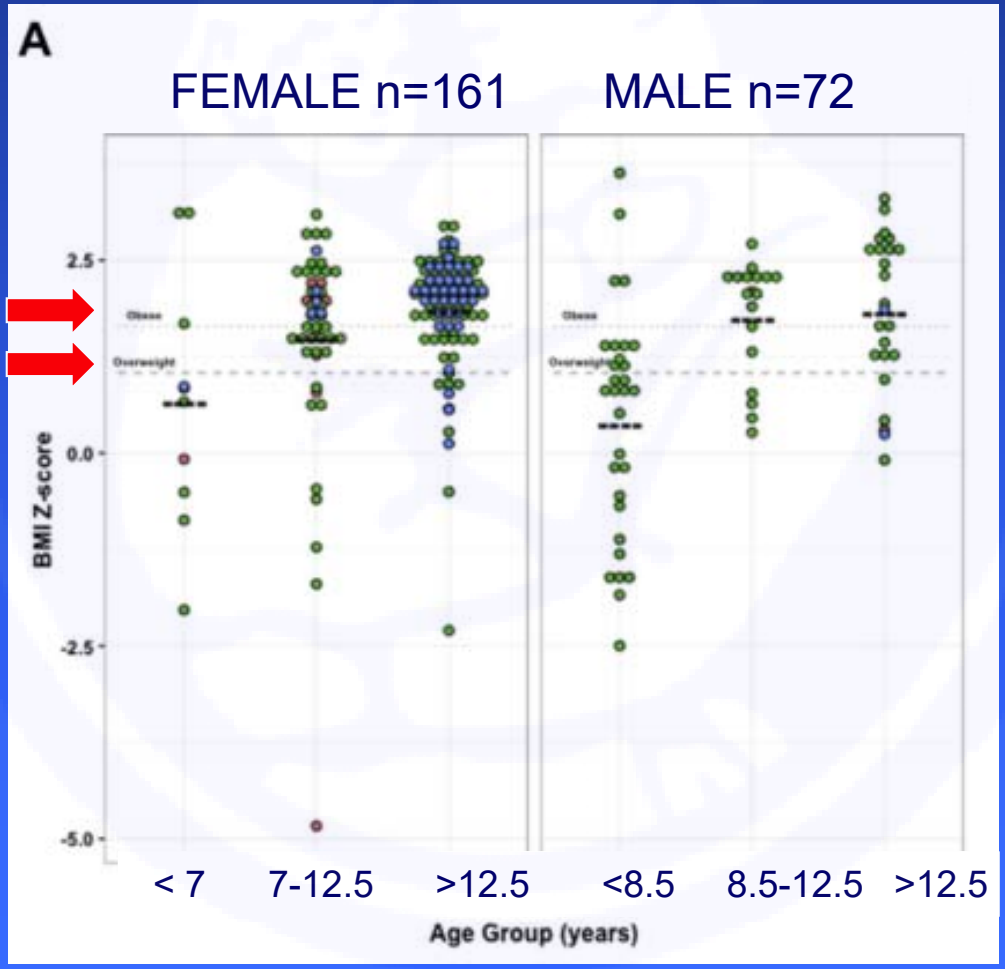
- In children, incidence of 0.63 in 100,000 age <18 (Gillson et al. Pediatr Neurol 2017.)

	Gender	Obesity
Pre-pubertal	Male = Female	Weak association
Pubertal	Female Study of 40 pediatric IIH pts – 50% age 3- 11 – 88% age 12- 14 – 100% age 15-17	Associated Study of 40 pediatric IIH pts Obesity as 120% ideal body weight – 43% age 3-11 – 81% age 12-14 – 91% age 15- 17 Balcer et al. Neurology 1999, 52:870.

Anthropometrics of Pediatric IIH

- Multicenter, retrospective study of children age 2-18 with IIH with papilledema (Sheldon et al. Ophthalmol 2016.)
  - 233 cases of IIH over 8 sites including Boston Children's Hospital

OBESE
OVERWEIGHT



Symptoms of Elevated ICP

- Symptoms
  - Position dependent headaches
  - Pulsatile tinnitus
  - Transient visual obscurations
  - Blurry vision
  - Diplopia
- Risk factors for asymptomatic presentation
  - Retrospective review at BCH 86 patients with pediatric IIH (Whitecross S, Heidary G. J AAPOS. 2013;17(1).
  - **21% were asymptomatic**

Variable	Asymptomatic	Symptomatic	P value
Mean Age at Diagnosis	9 years	13 years	0.01
Mean opening pressure	33 cm H20	37 cm H20	0.07
Mean Body Mass Index	22 kg/m^2	30 kg/m^2	0.01

Signs of Elevated ICP

- Decreased vision
- Visual field defect
- Cranial nerve palsy (VI, VII, less commonly IV)
- Dyschromatopsia
- Bilateral optic nerve edema
- Absence of focal neurological signs

Neuroimaging Assessment

- Neuroimaging including MRI brain/orbits with and without gadolinium

- MRV head at Boston Children's
  - Retrospective review of neuroimaging in 360 patients <18 years with IIH or papilledema
  - 360 charts were reviewed
  - 72 patients with MRV
    - 14% had dural sinus thrombosis (DST)
    - 60% of these patients had occult DST (8% of the total cohort)

(Hollander JN, Prabhu S, Heidary G. J AAPOS. 2014;18(4):2.)

Diagnostic Assessment

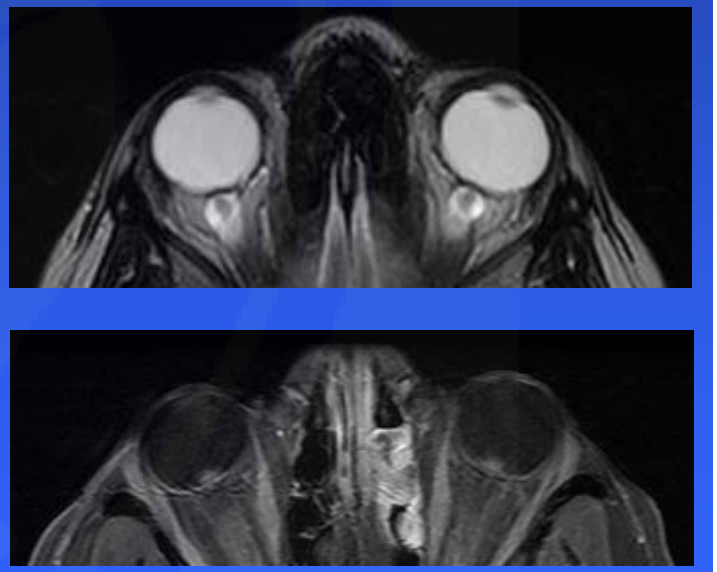
- Radiographic features of IIH in adult patients
  - Flattened posterior sclera
  - May have empty sella turcica
  - Enlarged perioptic subarachnoid space
  - Intraocular protrusion of nerves into globes

(Brodsky and Vaphiades, Ophthalmol, 1998, 105: 1686-1693.)

Diagnostic Assessment

- Radiographic Features of Pediatric IIH
  - Case control study 38 pediatric IIH patients and 24 controls
  - Neuroimaging including MRV when performed was reviewed
  - Clinical features of IIH cohort were reviewed

Radiographic Signs	IIH Patients	Control Group	Univariate p-value
Mean perioptic subarachnoid diameter space, mm	5.7 ± 0.7	5.0 ± 0.6	<0.001*
Posterior globe flattening (%)	28 (74)	0 (0)	<0.001*
Optic nerve protrusion (%)	17 (45)	0 (0)	<0.001*
Empty sella (%)	20 (53)	2 (8)	<0.001*
Transverse sinus narrowing (%)	20/29 (69)	9 (38)	0.029*
Skull base crowding (%)	1 (3)	1 (4)	1.000
Prominent arachnoid granulations (%)	3 (8)	5 (21)	0.242



(Gilbert AL, Vaughn J, Robson C, Whitecross S, Heidary G. J AAPOS. 2016;20(4):1.)

Diagnostic Assessment

- Confirmation by lumbar puncture with normal CSF
  - Historically accepted opening pressure > 20 cm H_20
  - Currently accepted opening pressure for children
    > 28 cm H_20 if LP required sedation
    > 25 cm H_20 if LP was unsedated or patient was obese

(Avery et al., NEJM, 2010, 363: 891.)

Revised Diagnostic Criteria

Required for diagnosis of pseudotumor cerebri syndrome[a]
A. Papilledema
B. Normal neurologic examination except for cranial nerve abnormalities
C. Neuroimaging: Normal brain parenchyma without evidence of hydrocephalus, mass, or structural lesion and no abnormal meningeal enhancement on MRI, with and without gadolinium, for typical patients (female and obese), and MRI, with and without gadolinium, and magnetic resonance venography for others; if MRI is unavailable or contraindicated, contrast-enhanced CT may be used
D. Normal CSF composition
E. Elevated lumbar puncture opening pressure (≥250 mm CSF in adults and ≥280 mm CSF in children [250 mm CSF if the child is not sedated and not obese]) in a properly performed lumbar puncture

(Friedman, Liu, Digre., Neurology, 2013; 81:1159-1165.)

Treatment

- ICP lowering medications
  - Acetazolamide
    10-25 mg/kg/day divided BID or TID
  - Furosemide
  - Topiramate
- Weight loss
  -Recommended 6-10% of total weight
- Surgical interventions
  -Temporizing lumbar drain
  -Optic nerve sheath fenestration
  -Neurosurgical shunt procedures

IIH Prognosis

- Visual outcomes
  - Historically, IIH was considered a benign process
  - Mid 80s, evidence of visual morbidity in pediatric IIH was being published

    5 patients with profound visual impairment or permanent visual field loss (Lessell and Rosman, Arch Neurol 1986.)

  - Reports of vision loss range from 13 to 38%

    One study of prepubertal children found visual field abnormalities in 85% of eyes and no light perception vision in 9% of eyes. (Cinciripini et al., Am J Ophthalmol 1999.)

    Puberty may be a risk factor for poor visual outcomes (Stiebel-Kalish et al., Am J Ophthalmol 2006.)

IIH at Boston Children's

- 86 pediatric patients with IIH with papilledema
  - January 2000 through December 2011
  - Age < 20 years
- Demographics
  - Mean age 12 years (range 2 to 19)
  - 53 patients (61%) were female
  - Mean BMI 27.8 (Std. Dev. 10.6)
  - Mean opening pressure 36 cm H20 (SD 10.7)

Clinical Presentation

- Mean duration of symptoms 2.4 months

Symptom	No. of Patients	%
Headache	65	76
Blurry Vision	29	34
Pulsatile Tinnitus	16	19
Diplopia	16	19
Transient Visual Obscurations	13	15
Nausea/Vomiting	9	11
Dizziness	8	9
Neck pain	7	8

Outcomes

- Visual Function
  - 2% of patients had 20/200 or worse vision
  - 23% of patients had permanent visual field deficits
- Optic nerve appearance
  - 15% of patients had optic atrophy
- Surgical treatment occurred in 12/86 (14%) patients
- 34% had at least 1 repeat lumbar puncture
- Percent recurrence 12/86 (14%) patients

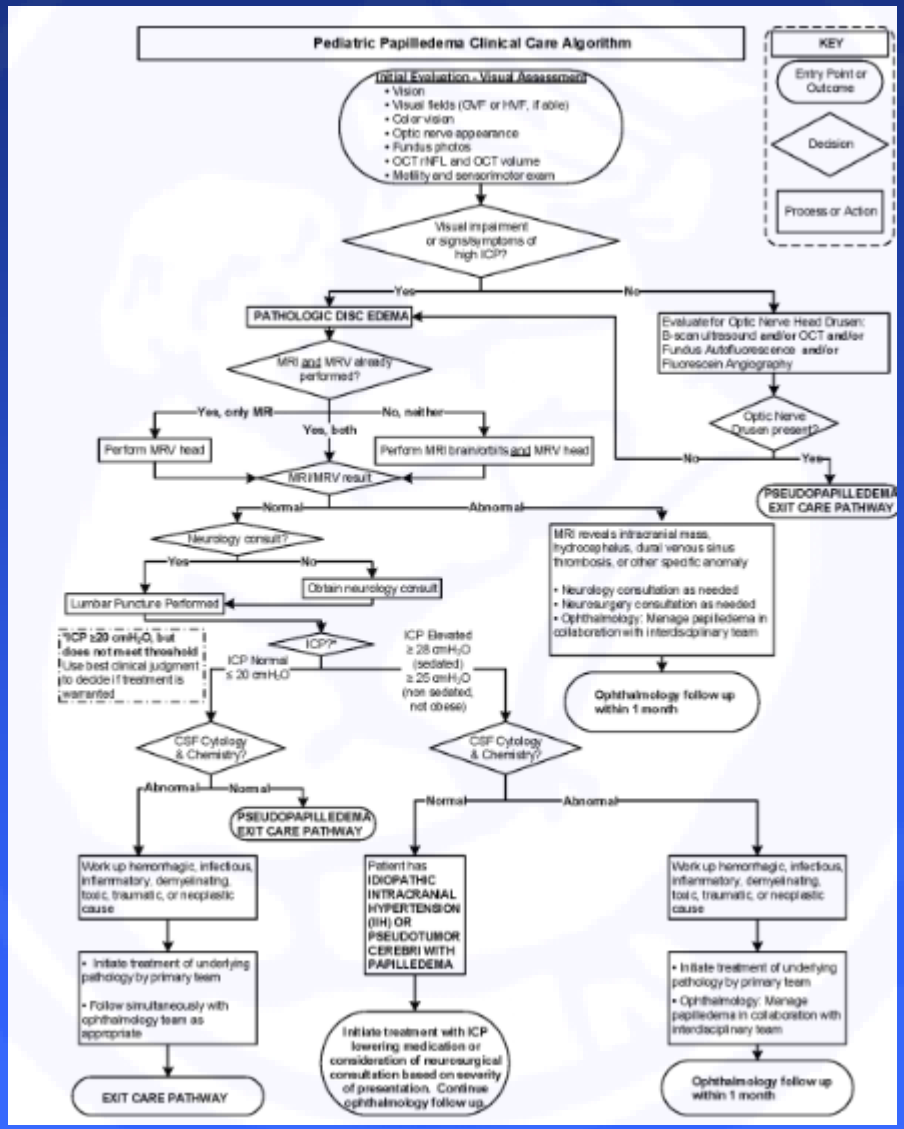
Questions

- How may we codify our assessment and management?
- May we develop better tools to monitor treatment response?
- What is the threshold for medical versus surgical intervention?
- What is the basis for recurrence of pediatric IIH?

Standardized Hospital Protocol

- Allows for consistency amongst providers for evaluation and treatment
- May be modified and improved based on outcomes
- Papilledema protocol was developed for BCH in 2011-2012

Papilledema Treatment Protocol



Heidary G. Int Ophthalmol Clin 2018 Fall;58(4):1-9.

Papilledema Treatment Protocol

Initial Evaluation - Visual Assessment

- Vision
- Visual fields GVF or HVF 24-2, if able
- Color vision
- Optic nerve appearance
- Fundus photos
- OCT nerve edema protocol
- Motility

Heidary G. Int Ophthalmol Clin 2018 Fall;58(4):4.

Future Directions

- Prospective natural history study of pediatric IIH?
- Pathogenesis of IIH in children
  - Is this a condition of CSF overproduction in children? (J AAPOS 2015 Apr;19(2):135-9.)
  - What is the contribution of pubertal status?
- Diagnosis and management
  - Utilization of adjunctive tools such as optical coherence tomography (OCT) to monitor papilledema and treatment response (J AAPOS 2007 Dec;11(6):564-70; JAMA Ophthalmol. 2017 Apr 1;135(4):320-328.)

Summary

- IIH is a condition of elevated ICP with normal neuroimaging and CSF
- In pre-pubertal children, there is no clear gender predilection or association with obesity
- Symptoms may include headache, visual changes, diplopia, and pulsatile tinnitus
- There is the potential for profound, permanent vision loss and prompt diagnosis is essential