Suspected optic disc oedema in children

How helpful is Ultrasound Optic Nerve Sheath Diameter Measurement?
Swollen discs, or not?
Then, how about these?
... and these?
Intracranial Pressure (ICP)

Measure:

Or deduce:

Imaging – ventricular dilatation
Fundoscopy - papilloedema
And then, there’s ultrasound...

Validation of the **optic nerve sheath response to changing cerebrospinal fluid pressure**: ultrasound findings during intrathecal infusion tests

Nocturnal Ultrasound Measurements of Optic Nerve Sheath Diameter Correlate with Intracranial Pressure in Children with Craniosynostosis.

Measurement of optic nerve sheath diameter by ultrasound: a means of detecting acute raised intracranial pressure in hydrocephalus
A-scan

A-scan graph showing:
- Gain: T= 75.6 dB
- Velocity (m/s): 1550
- Distance (mm): 6.24
Qualitative assessment
Validity and normative data may vary

<1 y. : 2,1-4,0 mm
>1 y. : 2,4-4,3 mm

Measurement of optic nerve sheath diameter by ultrasound: a means of detecting acute raised intracranial pressure in hydrocephalus
Validity and normative data may vary


5.85 mm +/- 0.66
Validity and normative data may vary


5.85 mm +/- 0.71
What use is US-ONSD in suspected optic disc oedema?

- Retrospective study of the US database 2007-2013 at Universitair Medisch Centrum Groningen

- Inclusion criteria:
  - age 0-16 years
  - suspected optic disc oedema assessed by ophthalmologist or paediatric neurologist or their trainees
**Methods:**
- A-scan
- B-scan: average horizontal and vertical measurement
- Qualitative assessment

**Search for relevant diagnosis of raised ICP in EPR**
- Assumption: the entire cohort will be referred to the UMCG for treatment (oncology, neurosurgery, radiotherapy)
- Extent of the neuro assessment varied (N=46) – not everyone had an MRI or an LP

**Outcome measure:**
- US-ONSD ≥ 5 mm and raised ICP
- US-ONSD < 5 mm and raised ICP
N=93 suspected optic disc oedema
(Out of 96: 2 had no quantitative scan results recorded, 1 had a double entry. 3 cases were contacted by telephone for relevant follow-up missing from EPR)

* FU 3-72 months, (mean 36, median 33)

* ONSD ≥ 5 mm: 46 cases
  * raised ICP: 10

* ONSD < 5 mm: 47 cases
  * raised ICP: 1
results

ONSD ≥ 5 + ^ICP (N=10)

* Diagnoses
  * IIH 5
  * GH replacement XO 2
  * Pilocytic astrocytoma 1
  * Fanconi Anaemia 1

* All had bilateral ONSD > 5

ONSD < 5 + ^ICP (N=1)

* Diagnosis
  * F 13 yrs, photopsia, visual difficulties, swollen discs, enlarged blind spot LE
  * ONSD 3.80 RE, 3.75 LE
  * normal MRI and 30 cm H₂O
results

ONSD ≥ 5 + ^ICP (N=10)

* Diagnoses
  * IIH 5
  * GH replacement XO 2
  * Pilocytic astrocytoma 1
  * Fanconi Anaemia 1

* All had bilateral ONSD > 5

ONSD < 5 + ^ICP (N=1)

* Diagnosis
  * F 13 yrs, photopsia, visual difficulties, swollen discs, enlarged blind spot LE

  * ONSD 3.80 RE, 3.75 LE

  * normal MRI, 30 cm H₂O on LP
results

Group with ^ICP (11)

* ONSD 5.00 - 7.55 mm (5.66)

* 5 had obvious qualitative signs of ONS distension

Group without ^ICP (82)

* ONSD 2.75 – 8.00 mm (4.77)

* 15 had obvious qualitative signs of ONS distension
## Results

<table>
<thead>
<tr>
<th></th>
<th>ICP raised</th>
<th>ICP normal</th>
</tr>
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<tbody>
<tr>
<td>ONSD ≥ 5 mm</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>ONSD &lt; 5 mm</td>
<td>1</td>
<td>46</td>
</tr>
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<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Sensitivity</td>
<td>91%</td>
<td>95 CI: 59-98%</td>
</tr>
<tr>
<td>Specificity</td>
<td>56%</td>
<td>95 CI: 45-67%</td>
</tr>
<tr>
<td>Positive likelihood ratio</td>
<td>2.0</td>
<td>95 CI: 1.52-2.82</td>
</tr>
<tr>
<td>Negative likelihood ratio</td>
<td>0.16</td>
<td>95 CI: 0.02-1.06</td>
</tr>
<tr>
<td>Disease prevalence</td>
<td>12%</td>
<td>95 CI: 6-20%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>22%</td>
<td>95 CI: 11-36%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>98%</td>
<td>95 CI: 89-100%</td>
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</table>
ONH drusen

N = 20

6 had enlarged ONSD
None had ^ICP
Swollen discs, or not?

ONSD  7.10 mm  6.85 mm

Reading difficulties, normal MRI, resolved symptoms
Then, how about these?

ONSD  6.60 mm  6.10 mm

IIH (LP 30 cm H₂O), renal insufficiency,...
... and these?

ONSD 5.40 mm

6.10 mm

Pilocytic astrocytoma
Conclusions from our review

- Wide range of ONSD within the “normal” population (2.75-8.00)
- Normal ONSD with raised ICP is possible
- ONH drusen may have enlarged ONSD
- PPV of ONSD with a cut-off of 5 mm is low (20%)
- But the NPV is high (98%)
- The PPV of a qualitatively normal looking ONS is also high (96%)
Suspected Raised ICP in the Absence of Papilloedema in Children with non-nown Intracranial Pathology

Just plugging…
Conclusions

“So, is it helpful?”

Maybe US-ONSD is better suited to rule out rather than confirm raised ICP

Never rely on US-ONSD alone in clinical decision making
Thank you MREH!