A tale too often told

N 28-year-old obese woman goes to the ED with severe headache, neck pain, nausea, & vomiting

N Normal examination, sent home as "migraine"

N 2 weeks – Decreased vision in both eyes, goes back to the same ED:
  • Head CT without contrast normal
  • Sent home
  • Outpatient neurology consultation arranged

N 3 weeks – Vision, headache worse
  • Neurologist: "normal examination"
  • Ophthalmologist…

A tale too often told

FUNDUS EXAMINATION SHOULD HAVE BEEN DONE ON DAY 1!

Ophthalmoscopy is not easy…

• Limited training
• Difficult without pupillary dilation
• Difficult and limited view
• Inability to recognize the findings

Disclosures

- No relevant disclosures
- Consultant for GenSight Biologics
**Non-mydriatic Fundus Photography**

**Direct Ophthalmoscopy**

---

**Fundus photography vs. Ophthalmoscopy**

**Trial Outcomes in the Emergency Department**

---

**Overall Goals**

- Show the feasibility of ED nurse practitioners obtaining quality photographs under routine conditions
- Show that non-mydriatic fundus photography is superior to direct ophthalmoscopy by ED providers
  - Whether photos read by neuro-ophthalmologists or the ED providers themselves

**General Methods**

- Systematically photograph all adult patients presenting to Emory ED with:
  - Headache
  - Acute focal neurologic deficits
  - Diastolic blood pressure > 120 mm Hg
  - Acute visual changes

**Phase 1**

- Direct Ophthalmoscopy ONLY
- Neuro-Oph
- Fundus Photography Readings within 24 Hours

**Phase 2**

- Photos
- Photos (Education)

**Phase 3**

- Photos
  - Ophthalmoscopy alone
  - 1734 photos
  - 350 patients
  - Photos (Education)
  - 2347 photos
  - 587 patients

**Phase 1**

- Photos
  - Ophthalmoscopy alone
  - 1503 photos
  - 354 patients
  - Photos (Education)
  - 2347 photos
  - 587 patients

**Phase 2**

- Photos
- Photos (Education)

**Phase 3**

- Photos
- Photos (Education)
Primary Outcome:

"Relevant Findings"

N Should change the patient’s care in the ED
N Compare the ED providers’ detection rate for relevant findings during the three phases

Optic disc edema
Isolated heme
Optic disc pallor
Retinal vasc. occlusion
Grade III/IV HTN
Cerebral venous thrombosis
End organ damage
High rate of readmission within 30 days
Stroke
Systemic disease
Tumor

NMFP in the ED is Feasible

Quick: Median photography session: 1.9 minutes (< 0.5% patient’s total ED visit)
Easy for patients and ED providers (they liked it)
Quality: Good enough to detect relevant findings in majority of patients

Methods: General Quality of 1734 photos/350 patients

Grade 5: Ideal quality
Grade 1: Inadequate for any diagnostic purpose
Grade 2: Unable to exclude all relevant findings
Grade 3: Only able to exclude relevant findings
Grade 4: Not ideal but still able to exclude subtle findings

3% no photos of diagnostic value (grade 1)
61% high-quality photos in both eyes (grade 4-5)
83% high-quality photos for at least one eye
Inter-observer agreement among the 2 neuro-ophthalmologists was very good (kappa 0.89)
Age ≤40 with increased quality

Methods: Presenting Complaints: Phase I

Headache: 65%
Focal Neuro: 29%
Visual: 26%
Diastolic BP: 6%
Presenting Complaints: Phase II

- Headache
- Focal Neuro
- Visual
- Diastolic BP

44 (12.6%) with relevant findings

- Disc Edema 29%
- II/IV HTN 23%
- III/IV HTN 17%
- Vascular Occlusions 9%
- Disc Pallor 9%
- Arterial Vascular Occlusion 3%
- Intraocular Hemorrhage 30%

Presenting Complaints: Phase III

- Headache
- Focal Neuro
- Visual
- Diastolic BP

35 (10%) with relevant findings

- Disc Edema 17%
- Hemorrhage 20%
- III/IV HTN 17%
- Vascular Occlusions 3%
- Disc Pallor 43%

ED Examination Method

- Direct ophthalmoscopy
- Non-mydriatic photography

# of patients’ fundi viewed by ED provider

- Phase I: 48/350 (14%)
- Phase II: 0/44 (0%)

# of abnormalities detected by ED provider

- Phase I: 44 (12.6%)
- Phase II: 74 (12.6%)
Patient arrives in ED => triaged

If chief complaint compatible with study, order for photographs automatically entered

Camera icon appears on EMR (Cerner FirstNet)

Phase II Methods

Photographs completed

Icon changes to an eye

Eye icon notifies ED provider that photos are available

ED provider provided one page form to record their review and findings

Phase I vs Phase II

<table>
<thead>
<tr>
<th>ED Examination Method</th>
<th>Phase I</th>
<th>Phase II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct ophthalmoscopy</td>
<td>48/350 (14%)</td>
<td>239/355 (68%)</td>
</tr>
<tr>
<td>Non-mydriatic photography</td>
<td>0/44 (0%)</td>
<td>16/35 (46%)</td>
</tr>
</tbody>
</table>

Phase II Conclusions

ED providers identified 46% of relevant findings on fundus photos

ED providers correctly identified 86% of normal fundi as normal on fundus photos

ED providers reported photographs as helpful in 52% of cases reviewed
Patient Care

ED: I have this patient with BP of 180/124 and headaches. Normal examination and normal CT scan of head. I have obtained fundus photos; they do not look normal. They should be on your phone.

Me: Oh, yes, it’s a grade IV hypertensive retinopathy.

ED: OK, I will admit him.

Me: Yes, sounds good.

Clinical Trials

ED: I have this patient with acute visual loss in the right eye one hour ago. I have obtained fundus photos; they do not look normal. They should be on your phone.

Me: Oh, yes, it’s a central retinal artery occlusion.

ED: OK, I will enroll him.

Me: Yes, sounds good.

Tele-Ophthalmology with the ED

The demise of direct ophthalmoscopy: A modern clinical challenge

Nonmydriatic Ocular Fundus Photography in Neurologic Emergencies

Ophthalmoscopy in the 21st century

Should We Stop Teaching Ophthalmoscopy to Medical Students?

What are the barriers to teaching ophthalmoscopy to medical students?

• Technically difficult
• Lack of confidence in the skill
• Under-appreciation of its utility
• Discouragement by preceptors


TOTeMS I Results
- M1s performed significantly better identifying fundus features with photographs (p<0.001)
  - 85% correct answers on photographs
  - Photographs > Simulator

- Fundus photographs were the easiest and least frustrating exam modality
- 70% preferred photographs to simulators for fundus assessment
- 49% said they would attempt direct ophthalmoscopy of clinical encounters over the next year

TOTeMS II Results - 1 year later
- Both the simulator and fundus photograph groups performed worse than one year prior
- M2s were again more accurate using fundus photographs than simulators (p<0.001)

- Fundus examination is more important than the method used
- Increase enthusiasm for fundus exam in medical education by including fundus photography
The Future is almost here

Nonmydriatic fundus photography
Portable devices
Interpretation
Teach in med school
Artificial intelligence
Teleophthalmology
Remote interpretation
Teleconsultation