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The TOS study: can we use our patients to help improve clinical assessment?

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ABSTRACT

Background: We believe that there is a need to increase awareness, particularly among foundation year doctors, of the importance of performing a full neurological examination, including ophthalmoscopy, in medical inpatients. Following a serious unexpected incident (missed papilloedema), we implemented a multifaceted intervention, including ensuring greater availability of equipment for neurological/ophthalmological assessment, education and curriculum redesign in two large teaching hospitals in the UK.

Methods: Following the results of our initial intervention, we introduced a patient assessment scoring system to evaluate patient recollection of the completeness of neurological examination by medical staff in the two Trusts over a four-month period.

Results: Of the 93 patients referred to neurology during this period, 33% could not recollect being examined with a tendon hammer and 48% said they had not been examined with an ophthalmoscope. In contrast, the majority (95.7%) remembered the use of a stethoscope in their examination. The data were fed back to medical staff which resulted in greater awareness of the importance of a complete neurological examination. No further adverse incidents of missed papilloedema were reported in the following 12 months, although it would be premature to state that this situation has been resolved.

Conclusions: A patient assessment score can be used by medical staff to raise awareness of the importance of a complete neurological examination from referring physicians.

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INTRODUCTION

Approximately 10% of patients seen in emergency departments and 10–20% of patients subsequently admitted to hospital have a primary neurological problem.[1] It is therefore essential that all patients are fully examined neurologically. Following a serious unexpected incident (SUI)[2] in 2008 (case 1 [Figure 1]), when a patient nearly went blind following an incomplete neurological examination, we introduced a number of strategies (audit, training, education and curriculum development) with the aim of improving the quality of neurological assessment, especially in relation to ensuring that an ophthalmoscopy is performed. The recurrence of further instances where potential ophthalmological conditions were missed (cases 2 and 3 [Figure 1]) after these interventions suggested that these strategies were not effective. We therefore gathered a simple patient assessment score by asking patients if they could recall being examined with a tendon hammer, ophthalmoscope and stethoscope (TOS). All inpatients referred to neurology in two acute Trusts over a four-month period were asked to recall the completeness of their neurological examination by referring physicians.

BACKGROUND

A review was carried out (following case 1) and resulted in the following actions: we increased the level of teaching (at undergraduate and postgraduate level) so that the issues in relation to ophthalmoscopy could be given more prominence in lectures, teaching and final year examinations; we also increased the number of available ophthalmoscopes; a meeting with the local medical school undergraduate curriculum committee was set up (to set specific learning outcomes for use of an ophthalmoscope); we sent an article on the importance of the use of ophthalmoscopes to all local Fellows of the Royal College of Physicians (London). We carried out Trust-wide surveys of foundation year doctors' level of confidence regarding the use of an

Case 1

December 2008: A 24-year-old woman was admitted with headaches and visual disturbance secondary to papilloedema from idiopathic intracranial hypertension. No assessment was made of her vision until day eight of her admission, when acuity was noted to be 6/24 bilaterally. She was transferred to have an emergency lumbar-peritoneal shunt and made a rapid recovery with appropriate weight reduction. She was asymptomatic in 2010 with visual acuity of 6/9 bilaterally.

Case 2

July 2010: A 19-year-old woman was admitted in July 2010 with headaches and papilloedema, two months post-partum and with a vague history of a possible fit two weeks previously. She was discharged after a normal (non-contrast) computed tomography head scan with a referral to the neurology department as an out-patient (in breach of the Trust papilloedema guidelines). She missed follow-up for five months, by which stage she was asymptomatic with 6/6 acuity bilaterally. Diagnosis was felt, in retrospect, likely to have been idiopathic intracranial hypertension due to weight gain and syncope.

Case 3

February 2011: A 30-year-old man was admitted with headaches, diarrhoea and vomiting and proven H1N1 influenza. He was discharged after a non-contrast computed tomography head scan and a lumbar puncture (with no pressure recording) and hence the correct test and diagnosis was missed. The patient was re-admitted three days later, symptomatically unchanged apart from noticing some visual blurring. On examination, he had marked papilloedema secondary to cerebral venous thrombosis noted on computed tomography venogram (Figure 2). The patient could not recollect having being examined with an ophthalmoscope until the second hospital admission. Seven months later, he is well with visual acuity of 6/9 bilaterally, following six months anticoagulation but still has mild bilateral optic disc swelling with enlarged blind spots.

FIGURE 1 Clinical details of three Serious Unexpected Incidents of 'mismanaged' papilloedema.

ophthalmoscope and of all consultant physicians regarding their educational expectations for medical students and trainees. We also published Trust-specific guidelines for management of papilloedema and added ophthalmology to the national 2010 foundation year curriculum.[3,4]

Following the occurrence of further SUIs (cases 2 and 3 [Figure 1]), a re-audit of the foundation year trainees' level of confidence revealed no significant difference (only 5% were aware of the Trust papilloedema guidelines). This led to the use of a patient assessment score (TOS) to evaluate how much patients could recall of their neurological examination.

METHODS

This study was performed in two hospitals in Birmingham: University Hospital Birmingham – Trust A (a teaching hospital with 1,200 acute beds) and Trust B – City Hospital (a teaching hospital with just under 1,000 acute beds) with a total of 93 patients over a four-month period. Our prospective, before and after study included patients under the care of the same group of doctors. Inpatients at two acute NHS Trusts (A and B) who were referred to the neurology department over a two month period (March – May 2011) were asked if they could recall being examined during their current admission with a tendon hammer (T), ophthalmoscope (O) or stethoscope (S). Following this period of data collection (phase 1) an email was sent to all junior doctors and consultants at the two Trusts explaining our study and the preliminary findings. We had significant concerns that a sizeable number of patients were not being assessed fully, so felt ethically bound to inform colleagues of our provisional results. We then re-audited over a further two-month period:

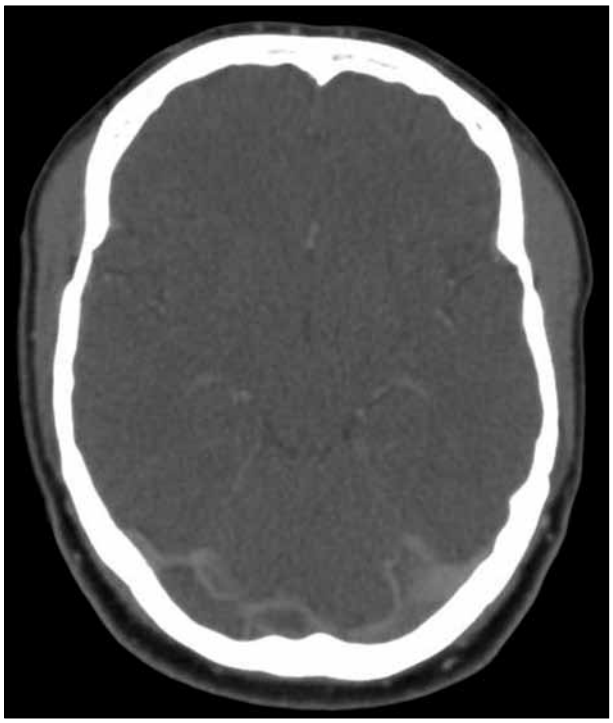

FIGURE 2 Right transverse sinus filling defect in keeping with cerebral venous sinus thrombosis. No abnormality was noted on a non-contrast computed tomography head scan (case 3).

TABLE 1 Recollection of neurological examination

			Tendon hammer (T)		Ophthalmoscope (O)		Stethoscope (S)	
Phase1	**Trust A**	Yes	15	50%	6	20%	29	96.7%
		No	15	50%	24	80%	1	3.3%
	Trust B	Yes	22	84.6%	19	73.1%	25	96.1%
		No	4	15.4%	7	26.9%	1	3.9%
Phase 2	**Trust A**	Yes	8	53.3%	6	40%	14	93.3%
		No	7	46.7%	9	60%	1	6.7%
	Trust B	Yes	17	77.2%	17	77.2%	21	95.5%
		No	5	22.7%	5	22.7%	1	4.5%

June and July 2011 (phase 2). We used Cochran's Q test to analyse the proportions of patients recalling being examined with a tendon hammer, ophthalmoscope and stethoscope. This test was applied because we had related samples and dichotomous variables.

RESULTS

Thirty patients at Trust A and 26 patients at Trust B were included in phase 1. At Trust A, 15 patients (50%) could not recall being examined with a tendon hammer, 24 (80%) with an ophthalmoscope, and one (3.3%) with a stethoscope. At Trust B, four patients (15.4%) could not recall being examined with a tendon hammer, seven (26.9%) with an ophthalmoscope, and one (3.9%) with a stethoscope. At Trust A, the majority of referrals were from the medical assessment unit (37%), followed by the medical and surgical wards (23% respectively), with the remainder from the Intensive Care Unit (10%) and the Emergency Department (7%).

Following the intervention, phase 2 included 15 patients at Trust A and 22 at Trust B. At Trust A, seven patients (46.7%) could not recall being examined with a tendon hammer, nine (60%) with an ophthalmoscope, and one (6.7%) with a stethoscope. At Trust B, five patients (22.7%) could not recall being examined with a tendon hammer, five (22.7%) with an ophthalmoscope, and one (4.5%) with a stethoscope (Table 1). Of note is that there were a greater proportion of referrals for possible seizures in phase 1 (nine patients, 30%) than in phase 2 (0 patients) and in Trust B in both phases (1, 3.8%; 1, 4.55%).

Using Cochran's Q test we found that there was no significant difference at Trust B between the proportions for tendon hammer (T), ophthalmoscope (O) and stethoscope (S) ($p=0.169$). However, there was a significant difference between the proportions for T, O and S ($p=0.002$) at Trust A. In particular, T and S and O and S were significantly different ($p=0.028$ and $p=0.002$) but T and O were not ($p=1.000$).

To establish whether the above results were simply due to a lack of equipment, the number of ophthalmoscopes in Trust A were counted. In total, there were 36 ophthalmoscopes: 20 (55.6%) working, 15 (41.7%) not working, and one (2.8%) missing. In the Emergency Department there were nine working ophthalmoscopes, however neither of the two patients referred from the Emergency Department in phase 1 could recall being examined with an ophthalmoscope. In the medical assessment unit there were four ophthalmoscopes but only one was working, which correlated with nine (81.8%) patients being unable to recall being examined with an ophthalmoscope.

CONCLUSIONS

We believe our study is the first to look at whether neurological patients recall being examined. It has shown that despite putting in place a wide range of educational and practical measures following potential SUIs at several hospitals, full neurology examinations were not being carried out and foundation year doctors still lacked confidence in their use of an ophthalmoscope. The consultants supervising them expect them to be competent in identifying papilloedema by the end of the foundation year, yet in spite of changing the curriculum, barely one in five felt confident in recognising papilloedema, 71% had used an ophthalmoscope less than ten times in the last six months and only 5% were aware of the guidelines that would have assisted them in recognising the condition. Although lack of equipment is clearly a problem in some areas, this is not the sole issue. During this study, Trust A had only one working ophthalmoscope in the main area where medical patients were assessed (yet five working magnetic resonance imaging scanners). After we presented this data, Trust A spent over £1,000 on new ophthalmoscopes, which went missing within two weeks.

One criticism of the TOS study is a lack of control data and the potential for recall bias. Short of the logistical

and ethical challenges of using covert filming, there is no final solution to the issue of poor recall. All patients were assessed within 72 hours of referral, typically by the next day, minimising the time between examination and questioning.[1] Poor patient recall was not raised as an explanation by any member of the medical staff of the two hospitals in feedback sessions. There is no particular reason why a patient would recollect being examined with one particular instrument over another although one could argue that being examined with an ophthalmoscope should be more memorable due to the (mild) discomfort of having a light shone in their eyes.

Since all junior doctors have their own stethoscope, we deliberately chose this question to assess for recall bias. The fact that the results (Table 1) were similar in both hospitals suggests that this was a reasonable assumption. One way to address the issue of recall bias would be to collect control data from neurology patient groups at the time of discharge from hospital, i.e. from a group of patients where it is known that they have been fully examined.

We consider our results provisional and are keen to collaborate with others to collect TOS data in different, global, healthcare settings. A similar TOS study in Saudia Arabia, for example, found evidence to suggest that neurological examination often was incomplete.[5] This suggests that the notation 'Neurology – NAD' (i.e. no abnormality demonstrated) may in fact mean 'not actually done'.

There are insufficient data to assess whether there was an improvement in TOS scores in the second phase or not. There were fewer referrals in the last two months, which is likely due to seasonal factors. We carried out the study at this time to see if there was any change in behaviour with the same cohort of junior doctors prior to them rotating to different departments. We were concerned about the potential for further 'near misses' during the study, so felt obliged to warn all colleagues in both Trusts, via email, that we were collecting TOS scores on all inpatient referrals to neurology. This has resulted in a lot of positive discussion. For example, one military physician, in response, highlighted that these aspects of examination could be performed in the field in a developing country, thus demonstrating the potential for the study to be replicated in a number of different healthcare environments (Figure 3).

The data demonstrate that a significant number of patients with a neurological problem are not being examined properly in these two hospitals. The worse results at Trust A may be due to the two years of interventions at Trust B (listed in methods section) which might have had an impact even if there was no effect on confidence levels between 2009–2011. Our study focused on secondary care, although a survey in primary care also noted a lack of confidence among GPs (only 56% felt confident in their use of an ophthalmoscope).[6]

FIGURE 3 Captain James Mitchell, showing that examinations could be performed in the field in a developing country, thus demonstrating the potential for the TOS study to be replicated in a number of different healthcare environments.

We would urge all neurologists and acute physicians on post-take ward rounds to assess TOS scores in patients with a neurological problem. This will serve both as an easy quality metric of a patient's neurological assessment, but also as a teaching technique to highlight the importance of the neurological examination. This of course also raises the question of quality; just because someone has been assessed neurologically does not necessarily mean that they have been assessed competently.

Neurophobia, the fear of neurology (through poor exposure at both undergraduate and postgraduate level) among medical students and junior staff may play a causative role in lack of examination skills.[7] If our findings are replicated, the TOS data are potentially a powerful instrument for change at multiple levels, just as the Apgar score was in neonatology. This could lead to staff being more neurophilic, i.e. developing a fascination for neurology.[8]

Our study highlighted the lack of ophthalmoscopes, despite the investment of £1,000 by Trust A, and we are now actively encouraging medical students to purchase their own ophthalmoscopes, as they currently do for stethoscopes. There is a misperception that equipment is expensive; one study found an effective ophthalmoscope for less than £1,[9] and a more recent one showed that cheaper equipment was as effective as more expensive items.[4] Newer technology, such as Eyephone adapters for iPhones need to be more fully tested and are currently more expensive but may prove to be effective tools.[10]

The importance of a thorough neurological and ophthalmological examination must be emphasised at undergraduate and postgraduate level. One recent study identified several UK medical schools which have neither an ophthalmology module nor an assessment of ophthalmological skills.[11] We are in the process of ensuring that there is a final year Objective Structured Clinical Examination (OSCE) which includes some form of assessment of the visual pathway. There is no consistent agreement on the best form of summative assessment of ophthalmoscopy – some have assessed the use of an eye model[12] as well as expensive simulation systems.[13] However, we suspect that student awareness that there will be an assessment of examination skill will provide an effective incentive.

Finally, it is worth remembering that TOS auditing is simple to perform; the cost of misdiagnosis is high (in 2004, a missed case of papilloedema in a girl with a blocked ventriculo-peritoneal shunt resulting in permanent blindness was settled in court for £275,000).[14]

All doctors should be confident in using these important clinical skills. Failing to perform complete physical examinations will lead to further near misses or actual patient harm.

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REFERENCES

1 Douglas MR, Peake D, Sturman SG et al. The inpatient neurology consultation service: value and cost. *Clin Med* 2011; 11:215–7.
2 National Patient Safety Agency. *What is a patient safety incident?* [Internet]. London: National Patient Safety Agency; 2011 [cited 2012 Apr 18]. Available from: http://www.npsa.nhs.uk/nrls/reporting/what-is-a-patient-safety-incident/
3 The Foundation Programme. *UK Foundation Year 2010 curriculum* [Internet]. London: The Foundation Programme; 2010 [cited 2012 Apr 18]. Available from: http://www.foundationprogramme.nhs.uk/pages/home/training-and-assessment
4 Mandal N, Harborne P, Bradley S et al. Comparison of two ophthalmoscopes for direct ophthalmoscopy. *Clin Experiment Ophthalmol* 2011; 39:30–6.
5 Nahrir S, Al Sinaidi O, Siddiqui R et al. *Neurology tools: usage frequency. A TOS study group.* American Academy of Neurology Annual Meeting: 2012. New Orleans; USA. p. 98.
6 Shuttleworth GN, Marsh GW. How effective is undergraduate and postgraduate teaching in ophthalmology? *Eye* 1997; 11:744–50.
7 Jozefowicz RF. Neurophobia: the fear of neurology among medical students. *Arch Neurol* 1994; 51:328–9.
8 Fuller GN. Neurophilia: a fascination for neurology – a new syndrome. *Pract Neurol* 2012; 12:276–8.
9 Armour RH. Manufacture and use of home made ophthalmoscopes: a 150th anniversary tribute to Helmholtz. *BMJ* 2000; 321:1557–9.
10 Bastawrous A. Smartphone fundoscopy. *Ophthalmology* 2012; 119:432–3.
11 Baylis O, Murray PI, Dayan M. Undergraduate ophthalmology education – a survey of UK medical schools. *Med Teach* 2011; 33:468–71.
12 Bradley P. A simple eye model to objectively assess ophthalmoscopic skills of medical students. *Med Educ* 1999; 33:592–5.
13 Limbs and Things. *Eye examination simulator* [Internet]. Bristol: Limbs and Things; 2002 [cited 2012 Apr 18]. Available from: http://limbsandthings.com/global/products/eye-examination-simulator/
14 Medical Negligence. *Bonehill v Hillingdon Hospital NHS Trust 2004* [Internet]. London: Medical Negligence Online; 2004 [cited 2011 Oct 5]. Available from: http://www.medneg.com/Case/CaseList.aspx