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CLINICAL STUDY

Goldmann tonometer calibration: a national survey

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Abstract

Introduction **Recent studies suggest that Goldmann tonometers can rapidly develop calibration errors (CEs) in clinical use and routine checks are necessary to ensure accuracy.**

Purpose **To determine current practice regarding CE checks in the United Kingdom and assess the views of senior nursing staff in charge of running ophthalmology outpatient clinics as to whom they feel to be responsible for CE checks.**

Methods **Every ophthalmology unit with training recognition in England, Northern Ireland, Scotland, and Wales was contacted. Senior nurses responded to a structured telephone questionnaire regarding local tonometer calibration practice and their views regarding who is responsible for CE checks. A total of 155 eye units were identified and contacted. The response rate was 100%.**

Results **CEs were checked for daily in 8 units (5.2%), weekly in 20 units (12.9%), fortnightly in 1 unit (0.6%), monthly in 12 units (7.7%), trimonthly in 5 units (3.2%), biannually in 27 units (17.4%), and annually in 21 units (13.5%). CEs were either never checked or checked in a very random manner (no identifiable pattern) in 61 units (39.4%). Sixty-three (40.6%) of the respondents felt CE checks were a departmental responsibility, 48 (31.0%) felt it to be the doctor's responsibility, and 44 (28.4%) felt CE checks should be performed by the nursing staff.**

Conclusions **Our national survey suggests that very few units check their tonometers for CEs at intervals which ensure their accuracy. Our previous survey of doctors suggests that they believe nurses should check for CE, whereas the nursing staff believe CE checks are not their responsibility. This lack of communication between health-care professionals may lead to inaccurate tonometers being used in clinical practice. We suggest that every eye unit should have a protocol, which clearly identifies individuals responsible for checking for CEs at least on a monthly basis.**

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Keywords: Goldmann applanation tonometer; calibration errors; practice in UK

Introduction

Despite being invented more than fifty years ago, Goldmann applanation tonometry remains the gold standard for the measurement of intraocular pressure (IOP). Haag–Streit (Koeniz–Berne, Switzerland) recommends calibration errors (CEs) of its Goldmann tonometers should remain within ± 0.5 mmHg, and that any tonometer found to be outside this range should be removed from clinical practice and returned to the manufacturer for recalibration.[1] However, they provide no guidelines or protocol as to how often the CE checks should be made.[1] A recent publication suggests that annual checking is normal practice. However, this is deemed to be insufficient to ensure tonometer accuracy.[2,3] The importance of timely CE checks has been emphasised by a recent paper, which suggested that tonometers lose their accuracy during routine clinical practice and may develop CE, which frequently over-estimate IOP.[2] A further issue which has not been addressed is whose responsibility it should be to ensure that tonometer calibration does take place. Doctors believe that CE checks are not their responsibility, and only a minority perform these checks on the tonometers they use. As each tonometer may be used by different doctors on a daily basis depending on the slit-lamp or clinic room used, this may place

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tonometer accuracy at risk.[3] This study evaluates the current practice regarding CE checks in the United Kingdom and assesses the views of senior nursing staff in charge of outpatient clinics as to whom they believe to be responsible for CE checks in their department.

Materials and methods

Every ophthalmology unit with training recognition in England, Ireland, Scotland, and Wales was identified from the Royal College of Ophthalmologists' *Directory of Training Posts in Ophthalmology 2005–2006*. At each institution, a senior nurse familiar with the day-to-day running of the outpatient ophthalmology clinic responded to a structured telephone questionnaire regarding the Goldmann tonometer CE checks. A follow-up telephone call was made when the respondent needed to check the details we required or was unavailable to participate due to clinical time constraints.

Respondents were asked how often all Goldmann tonometers in clinical practice were checked for CE, and whom they felt to be responsible for checking tonometers for CE (doctor/nurse/departmental responsibility).

Results

A total of 155 eye units were identified in the UK and contacted. A 100% response rate was achieved. All responding units were using Goldmann applanation tonometers in routine clinical practice.

CEs were checked for daily in 8 units (5.2%), weekly in 20 units (12.9%), fortnightly in 1 unit (0.6%), monthly in 12 units (7.7%), trimonthly in 5 units (3.2%), biannually in 27 units (17.4%), and annually in 21 units (13.5%). CEs were either never checked or checked in a very random manner (no identifiable pattern) in 61 units (39.4%). Units where the CEs was checked 'occasionally', 'never', 'if required', or 'in no particular time scale' were included in this last group.

In all, 63 (40.6%) respondents felt CE checks were a departmental responsibility, 48 (31.0%) felt it to be the doctor's responsibility, and 44 (28.4%) felt CE checks should be performed by the nursing staff.

Discussion

IOP measurement is a fundamental part of routine ophthalmic examination and an important variable in the management of glaucoma.[2–4] The early manifest glaucoma trial showed that decreasing IOP by 1 mmHg leads to a 10% reduction in the risk of progressive nerve damage.[4] Documented sources of error in IOP measurement using an applanation tonometer include corneal thickness, eyelid squeezing, and tight neck-ties which overestimate IOP; increased fluorescein and tear-film volume, poor illumination and number of tonometer contacts which underestimate IOP, while corneal astigmatism, interobserver, and CEs have a variable effect on IOP.[2,5]

The manufacturer suggests an acceptable CE of ± 0.5 mmHg. Tonometers showing a CE beyond this range must be sent for recalibration and removed from clinical practice.[1] Sandhu *et al*[2] demonstrated that only 10% of their studied tonometers fell within the manufacturer's CE range. Wessels and Oh[6] have demonstrated that tonometers in routine clinical use may develop CE outside the manufacturer's recommendations within two weeks of routine clinical use. They also suggest that new tonometers checked within 3 months of purchase may develop CE in the range of 1.5–3.25 mmHg.[6] Whitacre and Stein[5] found an average CE of ± 2.0 mmHg in tonometers studied in their clinical environment.

CEs are more likely to deviate into the positive, rather than negative range. This may have the effect of overestimating IOP measurements. This loss of tonometer accuracy may have a significant effect on a patient's clinical management.[2,3,6]

Studies demonstrate that the Goldmann applanation tonometer requires frequent CE checks to ensure that its accuracy is maintained within the manufacturer's guidelines.[2–6] To the best of our knowledge, there are no published guidelines regarding the frequency at which CE checks should be made.

Our previous study on the practice of doctors in the UK with regard to CE checks and their opinion on who was responsible for CE checks showed that 85% had never checked tonometers for CE. A total of 70% of responding doctors felt that calibration checks were not their responsibility. They believe that either nursing staff or other hospital staff (eg Medical Physics Department) should carry out calibration checks and ensure the accuracy of tonometers.[3]

Our current survey shows that many eye units are not having CE checks done on a routine basis. A third have CE checks done at more than trimonthly intervals, and only a quarter had CE checks done within monthly intervals.

Ideally, tonometers should be checked for CE at each time they are used. Our previous study suggests that despite using a different tonometer by a different doctor for every clinical session, only a minority of units are checking the tonometer for CE on a daily basis.[3]

This survey highlights the lack of consensus regarding who is responsible for CE checks. Despite more than a quarter of the responding nurses believing nurses are responsible for CE checks, this is not translated into clinical practice. CE checks are not being performed at a

sufficient frequency, to ensure the accuracy of tonometers to be maintained. A third of responding nurses believe that it is the doctors who should be responsible for CE checks and 40% believe it is a departmental responsibility (eg Medical Engineering).

When taken in context with our previous survey of doctors these findings suggest that the lack of understanding and consensus between the two groups of health-care professionals with regard to CE checks is leading each side to a feeling that CE checks are not their responsibility. This results in inadequate CE checks which may render the instrument outside of its recommended accuracy range.

It is important that all eye units should develop departmental protocols regarding calibration checks. An individual or a group of individuals in each department (nurses/doctors/medical engineers/other trained personnel) must be clearly identified and held accountable for checking the calibration of all departmental tonometers at regular intervals. We recommend that tonometers should be checked for CEs at least on a monthly basis.

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