

24-hour intraocular pressure measurement in glaucoma

Iain Davidson, Katie Hoban, Andrew J. Tatham

CASE REPORT

A 62-year-old female with normal tension glaucoma presented with progressive visual field loss in the right eye. Her intraocular pressure (IOP) measured 15 mmHg using Goldmann applanation tonometry and IOP had been at similar consistently low levels at previous visits during office hours.

24-hour contact lens sensor recording was performed on the right eye using the “Triggerfish” CLS (SENSIMED Inc., Switzerland), a new FDA approved telemetric sensor that allows wireless monitoring of diurnal changes in ocular dimension related to changes in IOP [1]. The contact lens sensor contains strain gauges that convert ocular dimensional changes into electrical signals (expressed in mV). Measurements were recorded for 30 seconds every 5 minutes for a full 24-hour period of normal activities. Data was transmitted wirelessly from the contact lens sensor to an antennae taped to the patients’ head and stored in a portable device worn around the neck. After 24 hours the contact lens sensor was removed and data was downloaded and analyzed. Using conventional tonometry, IOP was 15 mmHg immediately prior to contact lens sensor insertion and 15 mmHg on removal of the device 24 hours later. However, the contact lens sensor revealed a large amplitude of diurnal variation between visits, with a peak measurement at 7 a.m. and

trough at 6 p.m. (Figure 1A). The contact lens sensor automatically identified the sleeping period by analyzing blink patterns, with blinks producing a transient spike in the electrical signal. A contact lens sensor recording for a patient with no significant diurnal variation is shown in Figure 1B for comparison.

DISCUSSION

Glaucoma, the most common cause of irreversible blindness, is an optic neuropathy characterized by progressive loss of retinal ganglion cells and accompanying loss of visual field. The major risk factor for glaucoma is raised IOP, however, many patients develop glaucoma or continue to lose vision, despite seemingly low IOP [2]. Measurement of IOP is typically restricted to office hours, but as IOP is subject to diurnal variation, many patients may have undetected high pressure. In fact, sleep laboratory studies have shown over 75% of people have a peak IOP during nocturnal hours [3].

Contact lens sensors offer the possibility of 24 hours IOP monitoring, with the potential to be used to determine timings of peak IOP and patterns of IOP variation without the expense and inconvenience of a sleep laboratory. Contact lens sensors also have the advantage of not needing to wake the patient or sit them up to obtain measurements, movements that themselves might influence pressure measurements.

Although it is still not certain whether IOP fluctuation is a risk factor for progressive visual loss in glaucoma, a recent study found eyes with higher amplitude fluctuations in IOP had faster rates of historical visual field deterioration [4]. Therefore, knowledge of magnitude of IOP fluctuations may allow better prediction of risk of visual loss and evaluation of treatment efficacy. The contact lens sensor may also help determine the most important time of day to measure IOP and capture peak levels [1]. This may allow the timing of medications to be individualized, particularly as sleep studies have shown some common anti-glaucoma medications such as beta-blockers are not effective over 24 hours [3].

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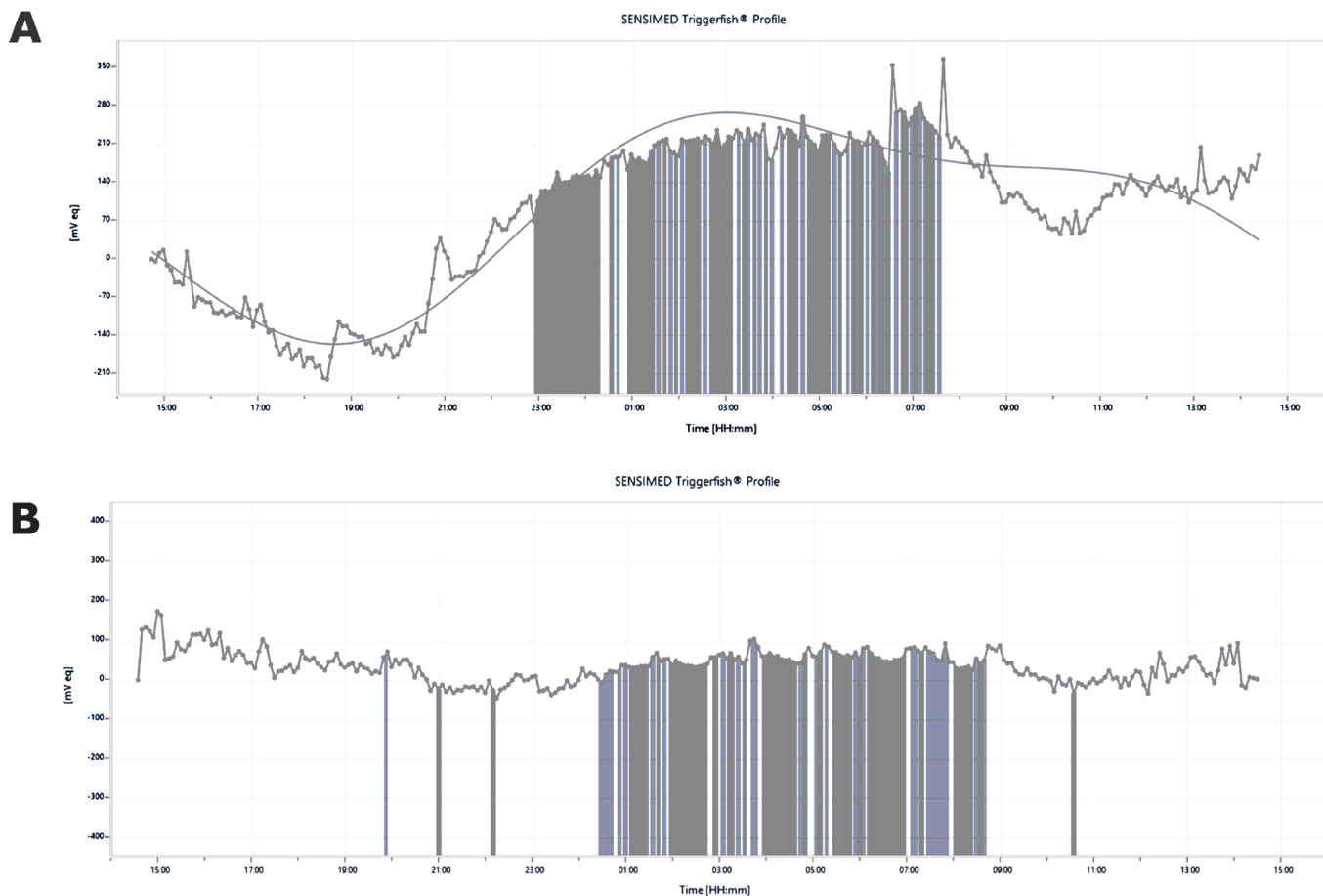


Figure 1: Contact lens sensor recording showing ocular dimensional changes over 24 hours in the 62-year-old patient with progressive glaucoma (A) The sleeping period was automatically identified by the CLS and is shown by the grey bars. (B) A contact lens sensor recording in a patient who had no significant fluctuation in measurements over 24 hours (B).

CONCLUSION

The successful management of glaucoma depends on lowering IOP, however, conventional methods of measuring IOP are limited as they allow only infrequent office hour readings. We used a contact lens sensor to obtain measurements over 24 hours in a patient with progressive glaucoma. Although the patient had consistently low IOP during the daytime, the contact lens sensor suggested a peak IOP during the early hours. Further studies are needed to determine whether the fluctuations detected using the contact lens sensor indicate higher risk of disease progression.

Keywords: Contact lens, Glaucoma, Intraocular pressure, Visual field

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Iain Davidson – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

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Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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