

COMPARATIVE ANALYSIS OF INTRAOCULAR PRESSURE MEASUREMENTS WITH DIFFERENT OPHTHALMOLOGIC DEVICES

Željko Kovačić, Lovro Bojić, Ivica Štambuk, Robert Stanić, Milan Ivanišević and Ljubo Znaor

University Department of Ophthalmology, Split University Hospital, Split, Croatia

SUMMARY – The aim of the study was to assess accuracy and reliability of automated intraocular pressure (IOP) measurement. This prospective study was carried out at outpatient glaucoma clinic, University Department of Ophthalmology, Split University Hospital in Split, over a 5-month period (September 2005 – January 2006). IOP measurements were performed by Goldmann's applanation tonometry and automated non-contact tonometry (Reichert AT 555). The study included 105 patients (210 eyes). In chronic open angle glaucoma (210 eyes) under therapy, the mean IOP value measured by Goldmann's applanation tonometry and automated non-contact tonometry was 19.85 mm Hg and 20.41 mm Hg, respectively. The difference was not statistically significant ($\chi^2=0.01215$; $p>0.05$). Accordingly, Goldmann's applanation tonometry and automated non-contact tonometry yielded similar results in chronic open angle glaucoma patients, confirming the accuracy and reliability of automated IOP measurement by non-contact tonometry.

Key words: *Goldmann's applanation tonometry, non-contact tonometry*

Introduction

The measurement of intraocular pressure (IOP) is one of the methods to assess the presence of risk factors in patients with glaucoma. Numerous techniques and devices of impression tonometry and since recently automated non-contact tonometry are currently available for IOP measurement.

Patients and Methods

The study was carried out at outpatient glaucoma clinic of the University Department of Ophthalmology, Split University Hospital in Split, Croatia, over a 5-month period (September 2005 – January 2006). This prospective study included 105 patients (210 eyes). IOP measurements were performed by Goldmann's applanation tonometer (GAT) and Reichert AT 555 automated

non-contact tonometer (NCT) with 10-minute between-measurement interval. Measurement results were analyzed by use of the Statistica for Windows, release 5.0 software (StatSoft, Inc., Tulsa, OK, USA), while \pm^2 -test and Mann-Whitney test were employed on statistical analysis. The level of statistical significance was set at $p<0.05$.

Results

The mean IOP as measured by GAT and NCT in 210 eyes on therapy for chronic open angle glaucoma was 19.56 mm Hg and 20.60 mm Hg, with standard deviation of 5.57 and 4.57, respectively. The difference in the distribution of IOP values between the two methods was not statistically significant ($\chi^2=0.01215$; $p>0.05$).

Discussion

Besides the gold standard IOP measurement by Goldmann's applanation tonometer, other techniques

Correspondence to: *Željko Kovačić, MD*, University Department of Ophthalmology, Split University Hospital, Spinčićeva 1, HR-21000 Split, Croatia

Received January 30, 2007, accepted March 26, 2007

have now also been introduced with variable success and accuracy. Automated non-contact tonometry is a promising option to find many applications, especially in studies where fast IOP measurement is required for timely detection of elevated IOP and glaucoma. The studies conducted by Stabuc Shilih *et al.*¹, Tonnu *et al.*², Tonnu *et al.*³, Otter⁴ and Stodtmeister⁵ showed the accuracy of IOP measurement to depend on the quality of corneal tissue (the central part of the cornea in particular) and distortion, the latter exerting considerable impact on non-contact tonometry measurements. Discrepancy between IOP values thus obtained increases with the rise in current IOP⁶. The measurements of IOP in our patients with chronic open angle glaucoma by use of two different techniques yielded a mean difference of 0.56 mm Hg, without statistically significant difference in IOP distribution. Differences of 0.6-1.2 mm Hg have been reported from other studies^{3,7-10}. Our results of IOP measurements were somewhat lower (at the lower limit) as compared with literature data, which could be attributed to the older age of our study population (mean age 74 *vs.* 63 years), expected to be associated with higher corneal rigidity. The study by Müller-Holz *et al.* was performed on the same instruments, Goldmann's applanation tonometer and Reichert AT 555 automated non-contact tonometer, however, in a considerably younger patient population (mean age 46 years). They report on measurement difference of 0.6 mm Hg, slightly (by 0.04 mm Hg) exceeding the one found in our study (0.56 *vs.* 0.6)¹¹. Graf *et al.* found a difference of 2 mm Hg between these two techniques of IOP measurement in 60% of study patients¹². Similar results were also obtained when IOP measurement was performed following keratomileusis¹³⁻¹⁵.

Non-contact tonometry is a noninvasive, rapid and reliable method of IOP measurement, requiring no local anesthetic or other eye drops, implying no risk of infection transmission, and is easy to perform. It is suitable for use in glaucoma studies and in the observation of glaucoma patients^{16,17}.

Conclusion

Goldmann's applanation tonometry and automated non-contact tonometry produce comparable results in chronic open angle glaucoma, thus proving the accuracy and reliability of IOP measurement by the latter technique.

References

1. STABUC SHILIH M, HAWLINA M. Influence of corneal thickness on comparative intraocular pressure measurements with Goldmann and non-contact tonometres in keratoconus. *Klin Monatsbl Augenheilkd* 2003;22:843-7.
2. TONNU PA, HO T, NEWSON T, EL SHIEKH A, SHORMA K, WHITE E, BUNCE C, GARWAY-HEATH D. The influence of central thickness and age on intraocular pressure measured by pneumotonometry, non-contact tonometry, the Tono-Pen XL, and Goldmann applanation tonometry. *Br J Ophthalmol* 2005;89:851-4.
3. TONNU PA, HO T, SHORMA K, WHITE E, BUNCE C, GARWAY-HEATH D. A comparison of four methods of tonometry: method agreement and interobserver variability. *Br J Ophthalmol* 2005;89:847-50.
4. OTTER K. Tonometry. *Insight* 1998;23:11-7.
5. STODTMEISTER R. Applanation tonometry and correction according to corneal thickness. *Acta Ophthalmol Scand* 1998;76:319-24.
6. MUNKWITZ S, THIEME H, BERCHRAKIS NE, FOERSTER MH. Comparison between the Nidek NT-4000 non-contact tonometer (with pulse synchronized IOP measurement) and the Goldmann applanation tonometer in patients with normal and elevated intraocular pressure (IOP). Berlin: Charite Campus Benjamin Franklin.
7. REGINE F, SCUDESI GL, CESAREO M, RICCI F, CEDRONE C, NUCCI C. Validity and limitations of the Nidek NT-4000 non-contact tonometer: a clinical study. *Ophthalmic Physiol Opt* 2006;26:33-9.
8. HANSEN MK. Clinical comparison of the XPERT non-contact tonometer and conventional Goldmann applanation tonometer. *Acta Ophthalmol Scand* 1995;73:176-80.
9. SONY PS. Applanation tonometer correlations. *Am J Optom Physiol Opt* 1977;54:834-6.
10. POPOVICH KS, SHIELDS MB. A comparison of intraocular pressure measurements with the XPERT noncontact tonometer and Goldmann applanation tonometry. *J Glaucoma* 1997;6:44-6.
11. MÜLLER-HOLZ MF, SPANIER J, SCHMIDT E, BOEHM AG, PILLUNAT LE. Comparison of IOP measurements obtained by the non-contact tonometer AT 555 and Goldmann applanation tonometry. Dresden: Universitäts-Augenklinik.
12. GRAF M, HOFFMANN OF. Reproducibility of results of two non-contact tonometers. Comparison with the Goldmann applanation tonometer. *Klin Monatsbl Augenheilkd* 1992;11:678-82.
13. PANY ZHONG Y, LIAN J, WANG K. Analysis of intraocular pressure and corneal thickness after laser in situ keratomileusis. *Zhonghua Yan Ke Za Shi* 1999;35:395-62.
14. EL DANASONSY MA, EL MAGHSABY A, COORPENDER SJ. Change in intraocular pressure in myopic eyes measured with contact and non-contact tonometer alter laser in situ keratomileusis. *J Refract Surg* 2001;17:97-104.

15. LISLE C, FLILERS N. A clinical comparison of the Xpert non-contact tonometer with Goldmann applanation tonometer after penetrating keratoplasty. *Acta Ophthalmol Scand* 2000; 78:211-5.
16. JORGE J, GONZALEZ-MEIJOME R, DIAZ-REY JA, ALMEIDA B, RIBEIRO P, PARAFITA MA. Clinical performance and non contact tonometry by Reichert AT 550 in glaucomatous patients. *Ophthalmic Physiol Opt* 2003;23:503-6.
17. KATUSHIMA H, SONE A, TAKEDA A, OKAZAKI H, ADICHI J, FUNAHASHI K, MARYAMA I. Effect of tonometry on glaucoma population study. *Nippon Ganka Gakkai Zasshi* 2002; 106:143-8.

Sažetak

USPOREDNA ANALIZA MJERENJA OČNOG TLAKA RAZLIČITIM OFTALMOLOŠKIM UREĐAJIMA

Ž. Kovačić, L. Bojić, I. Štambuk, R. Stanić, M. Ivanišević i Lj. Znaor

Cilj studije bio je provjeriti točnost i pouzdanost mjerenja očnog tlaka (IOT) automatskom metodom bez dodira. Studija je provedena u Klinici za očne bolesti Kliničke bolnice Split, u Ambulanti za glaukom, a obuhvatila je bolesnike s glaukomom liječene u razdoblju od 5 mjeseci, od rujna 2005. do siječnja 2006. godine. U ovoj prospektivnoj studiji ispitano je 105 bolesnika (210 očiju). Mjerenja IOT izvedena su Goldmannovom aplanacijskom tonometrijom i automatskim mjerenjem IOT bez dodira tonometrom Reichert AT 555, s međuvremenom u mjerenjima od 10 minuta. Mjerenjem IOT pod terapijom za kronični glaukom otvorenog kuta (210 očiju) Goldmannovom aplanacijskom tonometrijom dobivena je srednja vrijednost od 19,85 mm Hg, a automatskim mjerenjem IOT bez dodira 20,41 mm Hg. Nije bilo statistički značajne razlike između ovih rezultata ($\chi^2=0,01215$; $p>0,05$). Dakle, mjerenje IOT kod kroničnog glaukoma otvorenog kuta Goldmannovom aplanacijskom tonometrijom i automatskom metodom bez dodira pokazalo je statistički slične vrijednosti, što potvrđuje točnost i pouzdanost mjerenja IOT tehnikom automatskog mjerenja bez dodira.

Ključne riječi: *Goldmannova aplanacijska tonometrija, automatsko mjerenje IOT bez dodira*

