DETECTION OF GLAUCOMA USING SisGlaTel: ACCEPTABILITY AND SATISFACTION AMONG PARTICIPANTS, AND PROBLEMS DETECTED

DETECCIÓN DE GLAUCOMA MEDIANTE TELEMEDICINA CON SisGlaTel: SATISFACCIÓN Y ACEPTACIÓN ENTRE LOS PARTICIPANTES Y PROBLEMAS DETECTADOS

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ABSTRACT

Purpose: To evaluate the problems, and the degree of acceptability and satisfaction among participants in a telemedicine screening program. This study forms part of a global project for the design, implementation and evaluation of SisGlaTel funded by the Fondo de Investigaciones Sanitarias (Spain) and Pfizer Ophthalmics.

Method: A telemedicine system was built based on a specific program written in JAVA™. The remote station was located at a Primary Care Center. Participants signed an informed consent, and completed a questionnaire and undertook different tests (frequency doubling perimetry-FDT, confocal scanning laser tomogafy-HRT and tonometry). Test results and problems detected were analysed. Ninety-nine subjects completed a satisfaction questionnaire after voluntarily participating in the screening program among an at-risk population. The questionnaire included 7 questions, four of which required participants to categorise their responses, ranging from very bad (1) to excellent (5), to questions

RESUMEN

Propósito: Evaluar las dificultades y el grado de aceptación y satisfacción entre la población participante durante una campaña de detección de glaucoma por telemedicina. Este trabajo es parte de un estudio global de desarrollo, aplicación y evaluación del SisGlaTel financiado por el Fondo de Investigaciones Sanitarias (FIS) y Pfizer Ophthalmics.

Método: Se desarrolló un sistema de telemedicina sobre un programa específico en JAVA™. Se instaló la estación remota en el Centro de Atención Primaria. Los sujetos participantes firmaron un consentimiento informado, y fueron sometidos a varias pruebas diagnósticas (perimetría de duplicación-FDT, oftalmoscopía con láser confocal-HRT y tonometría). Se analizaron los resultados de las pruebas y los problemas observados en la aplicación del sistema. Se realizó una encuesta a 99 personas que acababan de participar voluntariamente en el programa de detección de glaucoma entre población de riesgo. La encuesta incluyó 7 pregun-

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about the screening program, its usefulness, the care received and the installations.

**Results:** Six hundred and forty-one at-risk subjects were examined. After 2 exams per eye, 22.3% (143) presented abnormal FDT and 4.2% (27) had pathologic HRT. One hundred percent of respondents affirmed they would participate again in a similar program. The mean qualification (SD) was 4.5 (0.6), 4.5 (0.6), 4.8 (0.5), and 4.3 (0.7) for global opinion, usefulness, care and equipment.

**Conclusion:** SisGlaTel allows integration of several diagnostic tests useful for glaucoma tele-screening. The global degree of satisfaction among participants was good (Arch Soc Esp Oftalmol 2008; 83: 533-538).

**Key words:** Glaucoma, telemedicine, screening, frequency doubling technology, scanning laser ophthalmoscopy.

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**INTRODUCTION**

Primary open angle glaucoma is a frequent optic neuropathy affecting 2.1% of the population over 40 in our country (1). It is characterized by the progressive loss of nervous fibers and deterioration of the visual function which may cause irreversible blindness. Open angle glaucoma is a non-symptomatic disease for the patient until it reaches advanced stages and the currently available therapies (drugs, laser and surgery) only serve to delay or hinder its evolution. For all these reasons, glaucoma is one of the major causes of blindness in industrial countries (6-21% of causes of blindness). Over half of all cases are not diagnosed even though the best treatment is early diagnosis. In its blindness prevention programs, the World Health Organization recommends specific measures for an early diagnosis of this disease.

Telemedicine consists in the utilization of telecommunications technology for providing ophthalmological medical care. It closes the gap between the most advanced technology and knowledge of highly specialized consulting practices and the general population. Telemedicine has a great potential in rural areas far from specialized medical care because it avoids patient and physician trips, it brings latest technologies and know-how within reach of the population and also facilitates follow-up programs.

One of the most developed telemedicine applications in ophthalmology is blindness prevention campaigns due to diabetic retinopathy. Recent studies on the application of telemedicine to glaucoma have been made, assessing ocular pressure or making use of various photo or video systems (2-7). Imaging instruments have been utilized for telemedicine detection of glaucoma (7,8). However, we have not found references in literature to the application of confocal laser ophthalmoscopy and frequency duplication perimetry. The sensitivity and specificity obtained after subjective evaluations by one or more ophthalmologists of papilla photos is in the area of 70% and 97% respectively (6).

The utilization of diagnostic tools able to obtain 3-D images of the papilla and a quick and function evaluation could enhance the diagnostic possibilities of telemedicine systems. In addition, said instruments are relatively easy to handle and do not require the participation of an ophthalmologist. A nurse, optometrist or trained technician could handle them and the results could be sent through the Internet in the form of a file. The TOSCA 2002 program for glaucoma detection, made in several European countries, was the first to include confocal laser ophthalmoscopy to telemedicine programs. No publication has been found about this European program.

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**Results:** Se evaluaron 641 sujetos con riesgo de sufrir glaucoma. El 22.3% (143) realizaron un FDT patológico y un 4.2% (27) presentaron un HRT patológico. El 100% de los encuestados afirmó su deseo de volver a participar en una campaña similar. La valoración media (DS) fue de 4.5 (0.6), 4.5 (0.6), 4.8 (0.5), y 4.3 (0.7) para la opinión general, la utilidad, la atención recibida, y las instalaciones, respectivamente.

**Conclusión:** El SisGlaTel permite integrar la información de distintas pruebas diagnósticas para detección de glaucoma por telemedicina. El grado de satisfacción entre los participantes fue bueno.

**Palabras clave:** Glaucoma, telemedicina, rastreo, perímetría de duplicación de frecuencia, oftalmoscopia con láser confocal.
The integration of a brief anamnesis, ocular pressure measurement, brief but precise functional and structural tests could be particularly efficient in a glaucoma detection system applicable in a remote environment via telemedicine. Such a system could assist in detecting many undiagnosed glaucoma cases and thus preventing blindness caused by this disease.

The instant project aims at assessing the difficulties and degree of acceptance and satisfaction among the participant population during the application of the SisGlaTel telemedicine system in a glaucoma detection campaign. This work is part of a global study for the development, application and evaluation of the SisGlaTel system financed by FIS and Pfizer Ophthalmics.

**SUBJECTS, MATERIAL AND METHOD**

**SisGlaTel**

The SisGlaTel telemedicine system was developed on a specific JAVA™ program and comprises several glaucoma diagnostic tests. The initial structure of SisGlaTel is showing in -figure 1. The program maintains communication between one or more remote centers and a data processing centre housing the database (MySQL). The system was built on a multi-platform basis with free software. It utilizes an Apache Tomcat application server housing all the communication processes between client and server. The system fulfills data protection regulations.

Identity data and pressure values are entered manually and the data files of the frequency duplication perimetry (FDT, Humphrey-Zeiss) and the Heidelberg Retina Tomograph (HRT, Heidelberg Engineering) are imported automatically. The data are transmitted to the server over the Internet after being encrypted and fragmented. The client computer does not store data. In the server, data are integrated, the FDT and HRT results are reconstructed and aggregated to the database. There the data are analyzed by an ophthalmologist who checks the quality thereof and issues a report.

In the initial version of this system, which is under review, all the HRT results beyond the limits of normality as per Moorfield Regression analysis of the HRT were classified as pathological. Likewise, the FDT with 3 adjacent points beyond 95% of normality and in the same hemi field were classified as pathological. In accordance with the results, the ophthalmologist (AA) issues a report recommending ophthalmological evaluation if the FDT and/or HRT were pathological and a regular evaluation if the IOP exceeded 21 mmHg and the tests were within the limits of normality.

**Application to target population**

The remote centre was installed in the primary health care of Plaza del Ejército in Valladolid, with the server being at the University clinic. Information panels were displayed to request the voluntary contribution of subjects at risk of suffering glaucoma. Specifically, the study recruited people over 65 and those who, being over 40, had a personal history of high ocular pressure or relatives with glaucoma. The volunteers went to the information desk or phoned the numbers indicated in the panels. The staff in charge of the campaign (nurses and optometrists) made contact with them and with a brief telephone interview made sure they met the inclusion criteria. Subsequently an appointment was made in which the participants were asked to
sign an informed consent and fill in a health survey, after which they were examined with an automatic refractometer, an HRT, an FDT and a non-contact air tonometer (INDO). At least two images were taken with the HRT, of which the best was chosen to evaluate the standard deviation, centering and focus. All the patients first made a supra-threshold C-20-5 test to become acquainted with the test and subsequently an N-30 test which was considered for analyzing the results. If any of the reliability indices exceeded 30%, the test was repeated.

**Satisfaction survey**

A survey was made among 99 volunteers who had just completed their participation in the glaucoma detection program for population at risk. The survey included 7 questions (fig. 2), of which 4 asked for selecting one choice of 5, ranging from very bad (1) to excellent (5) to assess the campaign in general, its usefulness, the attention they were given and the facilities. Another question asked if the volunteer would participate in another similar campaign. Finally, the survey asked for comments and suggestions for improving the campaign.

**Data analysis**

The total and partial exploration times were recorded as well as the incidents or events found. The data were analyzed with descriptive statistics.

**RESULTS**

In total, 641 subjects took part in the campaign, 400 women (63%) and 241 men (37%). Their mean age (SD) was of 65.4 (10.5) years and the mean intraocular pressure (SD) was of 16.2 (3.8) mmHg (range 5 to 29 mmHg). After two explorations with the FDT, 22.3% of the subjects (n: 143) exhibited a pathological FDT. The HRT was pathological in 4.2% of the study subjects (n: 27). It was not possible to obtain good quality HRT images in 31 subjects (4.8%). In addition, 24 patients had both pathological FDT and HRT concurrently (3.7%). The intraocular pressure exceeded 21 mmHg in at least one eye in 17.1% of participants (n: 110). The mean overall exploration time (SD) per patient was of 49 (18) minutes, and this time ranged between 25 and 115 minutes.

One hundred percent of the survey respondents stated their willingness to participate again in a sim-

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1. ¿Qué opinión le merece la campaña de detección de glaucoma en la que ha participado?
   - Excelente □
   - Muy buena □
   - Buena □
   - Regular □
   - Mala □

2. ¿Volvería a participar en una campaña similar?
   - SÍ □
   - NO □
   - ¿Por qué? ...............................................................................................................................

3. Utilidad de la campaña.
   - Excelente □
   - Muy buena □
   - Buena □
   - Regular □
   - Mala □

4. ¿Cómo calificaría la atención recibida por el personal de la campaña?
   - Excelente □
   - Muy buena □
   - Buena □
   - Regular □
   - Mala □

5. ¿Cómo calificaría las instalaciones de la campaña?
   - Excelente □
   - Muy buena □
   - Buena □
   - Regular □
   - Mala □

6. ¿Qué aspectos de la campaña cree que deben ser mejorados?
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   ...........................................................................................................................................

7. Comentarios adicionales:
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**Fig. 2: Content of the satisfaction survey given to 99 campaign participants.**
The mean evaluation (SD) was of 4.5 (0.6), 4.5 (0.6), 4.8 (0.5), and 4.3 (0.7) for the general opinion, usefulness, attention received and facilities, respectively. The suggestions for improvement included repeating detection campaigns at regular intervals, as well as longer campaigns so that a larger number of volunteers could participate.

As for the drawbacks or shortcomings, the following are of note. Firstly, the necessity of providing specific training and motivation for the primary care personnel to enhance the reliability, usefulness and brevity of the explorations. The instruments are relatively easy to use but require a certain amount of experience which is obtained in a matter of days rather than hours for anyone who is not familiar with them. Secondly, it was seen as necessary to have a DSL connection with fixed Internet Protocol (IP) instead of variable IP as is usually the case in order to apply the security protocols of the telemedicine system. Thirdly, staff without previous perimetric experience needed a relatively long time to carry out psychophysical tests, which extended up to 50 minutes the overall exploration time in accordance with the initial protocol. In addition, many details of system management computer application need to be adapted to enhance their user friendliness for administrative personnel, flexibility and applicable to clinics and for large populations.

DISCUSSION

Telemedicine is being utilized with different purposes in order to reduce health costs and improve quality of attention. In ophthalmology it is used mainly for detecting retinal diseases. It has developed mostly in the USA than in Europe. Although there are some papers about the application of telemedicine in glaucoma, we have not found in the literature any specific tools integrating the application of an imaging method with a psychological and physical test for diagnosing glaucoma. This study is part of a global study for the development, application and evaluation of SisGlaTel. Specifically, it is focused on the evaluation of the degree of patient satisfaction and a description of the problems encountered in the application of the system to the target population.

Most of past experiences on glaucoma diagnostic via telemedicine are based on the interpretation of photos of the optic nerve (2-6). Belait et al utilized HRT for detecting glaucoma and compared various degrees of compression of the images and proved that a compression of 10:1 allows for the transmission of images having enough quality for evaluation and classification (9). De Mul et al utilized confocal laser polarimetry (GDx) and images obtained by optometrists to detect glaucoma (8). The quality of the images was sufficient in 89% of cases and 27% of evaluated cases were referred to the specialized practice for additional evaluation. The numbers are similar to those obtained in this study in which 24% of participants exhibited pathological results and who were recommended to request ophthalmological attention. The degree of acceptance and satisfaction of participants ranged from good to excellent.

The problems found included the high overall exploration time in the initial system configuration. The inclusion of a functional and also a structural test in the detection protocol provides better results in what concerns diagnostic precision. However, fifty minutes may be adequate for a complete exploration in a practice which is specialized in glaucoma but not for detection campaigns among numerous risk groups. The FDT N30 program was selected because previous studies have demonstrated its greater sensitivity in early glaucoma stages (10) in comparison to shorter programs which utilize a supra-threshold strategy (C-20-5). However, the exploration time and the learning curve might be a little steep for applying the program to large population groups without previous experience in perimetry. These findings confirm the need for a cost-effective evaluation of SisGlaTel, after introducing the current improvements, to determine the health and financial aspects of its application to risk population groups.

In summary, SisGlaTel allows for the integration of several glaucoma diagnostic tests and the interconnection of several remote centers with a server. The issues detected in this study are being utilized for improving this detection system.

REFERENCES


