Teleophthalmology as a screening for Diabetic Retinopathy

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Abstract

Introduction: Teleophthalmology is an area that enables the diagnosis, treatment, research and tracking of diseases, all through the use of technology with continued educational opinions and synchronous and asynchronous care in order to speed up the resolution of cases of ophthalmological follow-up, reduction of the waiting queue, gain of time. The objective of this study was to prepare a systematic review of the literature on the use of Teleophthalmology as a screening for DR in Basic Care and the Comorbidities from DR. Method: The content was organized with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The collection of the articles began on July 6, 2019, using the Virtual Health Library, databases: LILACS, SCIELO and MEDLINE. Descriptors: Diabetes Mellitus, Diabetic Retinopathy and Teleophthalmology. Results and discusion: Through the descriptors, 32,882 articles were selected, after applying the filter 2 (inclusion criteria), 3 (exclusion criteria) and 4 (research question), the final sample comprised 15 articles. However, the use of teleophthalmology, although premature, deserves investment and improvement, because the added benefits aim at the health and quality of life of patients with diagnosed Diabetes Mellitus, evolving to DR. Conclusion: The data examined brought clarity about the empowerment of SUS, for early diagnosis and information through telemedicine. Key Words: Diabetes Mellitus; Diabetic Retinopathy; Teleophthalmology; Telemedicine

Resumen

Examén de teleoftalmologia para la Retinopatia Diabética

Introducción: La teleoftalmología es un área que permite el diagnóstico, el tratamiento, la investigación y el seguimiento de enfermedades, todo ello mediante el uso de tecnología con opiniones educativas continuas y atención sincrónica y asincrónica dirigida a acelerar la resolución de los casos de seguimiento oftalmológico, reduciendo la cola, ahorrando tiempo. El objetivo de este estudio fue preparar una revisión sistemática de la literatura sobre el uso de la Teleoftalmología como un dispositivo de rastreo para la Atención Básica y las Comorbilidades provenientes de la RD. Metodo: El contenido se organizó con el método (PRISMA) Preferred Reporting Items for Systematic Reviews and Meta-Analyses. La recopilación de los artículos comenzó el 6 de julio de 2019, utilizando la Biblioteca Virtual de Salud, bases de datos: LILACS, SCIELO y MEDLINE. Descriptores: Diabetes Mellitus, Retinopatía Diabética y Teleoftalmología. Resultados y discusión: A través de los descriptores se seleccionaron 32.882 artículos, tras aplicar el filtro 2 (criterios de inclusión), 3 (criterios de exclusión) y 4 (pregunta de investigación), la muestra final comprendía 15 artículos. Sin embargo, el uso de la teleoftalmología, aunque prematuro, merece una inversión y una mejora, porque los beneficios añadidos tienen como objetivo la salud y la calidad de vida de los pacientes a los que se les diagnostica diabetes mellitus, evolucionando a la RD. Conclusión: Los datos examinados aportaron claridad en cuanto a la potenciación del SUS, para el diagnóstico temprano y la información a través de la telemedicina.

Palabras clave: Diabetes Mellitus; Retinopatía Diabética; Teleoftalmología; Telemedicina

Resumo

Teleoftalmologia como rastreameto da Retinopata Diabética

Introdução: Teleoftalmologia é uma área que possibilita o diagnóstico, tratamento, pesquisa e rastreamento de doenças, tudo mediante uso da tecnologia com opiniões educacionais continuadas e atendimentos síncronos e assíncronos visando acelerar as resoluções dos casos de acompanhamento oftalmológico, redução da fila de espera, ganho de tempo. O objetivo desde estudo foi elaborar uma revisão sistemática da literatura, sobre o uso da Teleoftalmologia como rastreamento da RD na Atenção Básica e as Comorbidades procedentes da RD. Método: O conteúdo foi organizado com método Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A coleta dos artigos iniciou em 6 de julho de 2019, utilizando a Biblioteca Virtual de Saúde, bases de dados: LILACS, SCIELO e MEDLINE. Descritores: Diabetes Mellitus, Retinopatia Diabética e Teleoftalmologia. Resultados e discussão: Através dos descritores, foram selecionados 32.882 artigos, após aplicar o filtro 2 (critérios de inclusão), 3 (critérios de exclusão) e 4 (pergunta de pesquisa), a amostra final abarcava 15 artigos. Contudo, o uso da teleoftalmologia embora prematura, merece investimento e aprimoramento, pois os benefícios somados visam à saúde e qualidade de vida dos pacientes com Diabetes Mellitus diagnosticada, evoluindo para RD. Conclusão: Os dados examinados trouxeram clareza quanto ao empoderamento do SUS, para diagnóstico precoce e informações através da telemedicina.

Palavras-chave: Diabetes Mellitus; Retinopatia Diabética; Teleoftalmologia; Telemedicina

introduction

Diabetes Mellitus (DM), is considered a chronic course disease that is defined as a metabolic disorder due to insufficient insulin production or defect in its action, or even both mechanisms, which consequently generate chronic hyperglycemia [1,2,3]; as well as Diabetic Retinopathy (DR) DM also has types: DM type 1, where an autoimmune process causes annihilation of the cells responsible for the production of insulin, pancreatic beta cells and DM type 2 has a multifactorial etiology that composes factors of genetic inheritance, eating habits and physical inactivity [1]. This condition, in turn, associated with the time of evolution of the disease [3,2], causes retinal microangiopathy, consequently evolving to the development of diabetic retinopathy. The DR has classifications according to the progression of the disease, being: the non-proliferative, moderate proliferative, severe proliferative and the presence of macular edema [3],

Chronic hyperglycemia is considered as one of the primordial factors for microangiopathy [4,5], and may impair the kidneys and eyes, the most common form is the eye, expressed by a type of retinal microangiopathy that leads to anatomical and biochemical changes in the retina, being characteristic of DR [1,4,5,6], DM-related microvascular course complications [7]. The forms of damage to the cellular mechanism at the beginning of the DR include: intracellular accumulation of sorbitol, oxidative stress through the high rate of free radicals, excessive non-enzymatic stimulation of proteinase, quinase C protein [1,2,4]. Initially the DR demonstrates alterations such as the haemato-retinal barrier breakage, generated by the vessels contained in the retina and in the pigment epithelium of the retina, which have responsibility to prevent the passage of macromolecules. The breakage of this barrier is caused by the opening of the occlusion zones of the endothelial cells, the rupture causes several complications such as: macular edema and neovascularization segment, which are precursors of blindness. Another alteration that can be mentioned of the DR in relation to the retinal capillaries is the loss of the experts, which are cells that make the endothelium of the retina permeable in patients with DM, generating thickening of the basal membrane of the capillary causing alteration in the diffusion of oxygen and decrease in contact of the experts with the endothelial cells, providing vascular changes in patients with DM. The most advanced feature of DM is the neovascularization segment, explained by the adhesion of polymorphonuclear leukocytes in the retinal capillary wall, causing occlusion, vascular overflow and future tissue hypoxia [1,4]. DR appears asymptomatically in the initial phases [3,6,8].

According to the Brazilian Society of Diabetes, the individual after 20 years of presence of DM, it is reported that DR is present in about 90% of patients with type 1 DM, and 60% in patients with type 2 DM, being necessary the early investigation of these patients for health prevention, promotion and treatment purposes [1].

Teleophthalmology is defined by a process that through photographs of the retina of patients aiming at the identification of ocular disorders, but specifically DR, such photographs are collected through a health professional previously trained and qualified in primary care units, and may also be in mobile units. Then, the photos are sent to the ophthalmologist for evaluation and forwarded again to basic attention units for positioning regarding the management of the evaluated patient, optimizing time and providing greater agility of exams and adequate treatment in a timely manner [4]. Such investment aims at the early detection of DR, and, along with it, reduces the probability of patients developing blindness [6].

The use of teleophthalmology, although emerging, and moving towards maturity, is an area that enables the diagnosis, treatment, research and tracking of diseases, all through the use of technology together with continued educational opinions and synchronous and asynchronous care aimed at accelerating the resolution of cases of ophthalmological follow-up, as well as disseminating access to the exam for patients in need of care, which in case of therapeutic approach, teleophthalmology will allow a link between DR and treatment in a timely manner. Teleophthalmology has a direct impact on the quality of service and patient care, functioning as a race against time through a specialized service using technology [3]. The objective of this study was to develop a systematic review of the literature regarding the use of Teleophthalmology as a tool for tracking diabetic retinopathy (DR) in Basic Care and the Comorbidities from DR.

Method

This is a systematic literature review study, organized according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method. The collection of the articles began on July 6, 2019, using the Virtual Health Library and the following databases: LILACS, SCIELO and MEDLINE, and with descriptors were used: Diabetes Mellitus, Diabetic Retinopathy and Teleophthalmology.

Inclusion and exclusion criteria for articles

The inclusion criteria applied were: publication year with five years of scientific validity (2014-2019), complete, free, available in full, only in Portuguese, that met the theme of the review and there was a link with the descriptors chosen. The exclusion criteria were: articles duplicated in databases, those that did not fit the inclusion criteria and that did not bring any answer to the research question ("How important is the use of teleophthalmology to track diabetic retinopathy (DR) in Basic Care and what are the comorbidities coming from DR?)

Extraction of data

There was the elaboration of a protocol to separate data from publications, through an instrument that contained such information: year of publication, authors, title, objective of the article, country of publication and magazine published. Later, Table 1 was formulated.

Table 1. Description of separate publications by year, author, title, objective, state/country, journal.

Year	AUTHOR	TITLE	OBJECTIVE	State/ COUNTRY	JOURNAL
2019	FERREIRA, NM, NUNES, CP.	The importance of early screening in diabetic retinopathy.	To identify the importance of early screening for diabetic retinopathy in patients diagnosed with diabetes mellitus.	Rio de Janeiro-Brasil	Journal of Family Medicine and Mental Health
2019	Hirakawa, TH, Costa, WDC, Nakahima, F, Ferreira, AIC, Ribeiro, LB, Ticianeli, JG,et al.	Knowledge of diabetic patients using the Single Health System about diabetic retinopathy.	To analyze the level of knowledge of diabetic patients, treated at SUS in the city of Boa Vista/Roraima, about DR.	Roraima-Brasil	Brazilian Journal of Ophthalmology
2014	Ponte, ASL.	The role of primary health care in diabetic retinopathy screening.	Bibliographic review, describing the available and most cost-effective screening methodologies.	Coimbra-Portugal	Master's Thesis
2017	Bem ÂJ.	Economic evaluation on diabetic retinopathy screening strategies in the Single Health System		Rio grande do sul-Brasil	PhD Thesis
2016	Mendanha, DBDA, Abrahão, MM, Vilar, MMC, Nassaralla Junior, JJ.	Risk factors and incidence of diabetic retinopathy.	To know the incidence of DR, as well as its risk factors.	Góias-Brasil	Brazilian Journal of Ophthalmology
2015	SILVA, MS.	Assistance trajectory of a sentinel event: the evaluation of the integral attention to the diabetic user in SUS from the severe diabetic retinopathy.	To evaluate the integral attention to the diabetic user in SUS, from the assistance trajectories of diabetic users complicated with severe diabetic retinopathy.	Recife- Brasil	PhD Thesis

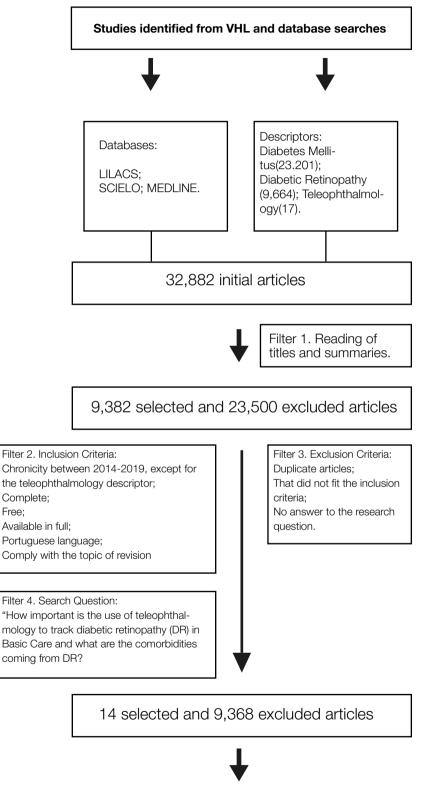| Year	AUTHOR	TITLE	OBJECTIVE	State/COUNTRY	JOURNAL
2014	Santos, R WVD, Loch, ACN, Sobrinho, EFDA, Alves, AP, Rocha, SPL.	Retinopathy in hypertensive and/or diabetic patients in a family health unit.	To identify the prevalence of alterations to direct ophthalmoscopy in patients diagnosed with hypertension and/or diabetes mellitus in a family health unit.	Belém do Pará-Brasil	Brazilian Journal of Ophthalmology
2018	Silveira, V, Malfatti, G, Romani, F, Vargas, JADA.	Updates in the management of diabetic retinopathy: literature review.	Evaluate updates in the treatment of diabetic retinopathy.	Rio Grande do Sul-Brasil	Medical records
2018	Bastos, CGM, Pfeil, JN, Gonçalves, MR, Araújo, ALD, Cabral, FC, Harzheim, E.	Innovation in telemedicine for the Unified Health System: TeleOphtalmo - look "gaucho".	To present the innovative project that uses telemedicine to bring visual health to patients in line for ophthalmologic consultations.	Rio Grande do Sul-Brasil	Brazilian Telehealth Newspaper
2020	Malerbi, FK, Carneiro, ABM, Katz, M, Lottenberg, CL	Retinal examinations requested in Basic Health Units: indications, results and alternative evaluation strategies.	To evaluate the indications, results and strategy of reign tests requested in Basic Health Units.	São Paulo-Brasil	Einstein
2014	Santos, AF, D'Agostin M, Bouskela, MS, Fernandéz, A, Messina, LA, Alves, HJ.	A panoramic view of the actions of telehealth in Latin America.	Systematize the vision of telehealth in Latin America and develop an instrument for monitoring the development of telehealth actions from the reality of the region.	Minas Gerais-Brasil	Panamerica Journal of Public Health.
2018	Celes, RS, Rossi, TRA, Barros, SGD, Santos, CML, Cardoso, C.	Telehealth as a response strategy of the State: systematic review.	To identify telehealth actions described in the literature as national health policy strategies.	Bahia- Brasil	Panamerica Journal of Public Health

Year	AUTHOR	TITLE	OBJECTIVE	State/ COUNTRY	JOURNAL
2017	Abreu, AC, Lages, V, Batista, P, Ribeiro, A, Menéres, P, Pessoa, B.	First 5 years of implementation of the Diabetic Retinopathy Screening Program at the Porto Hospital Center.	To characterize the population of diabetics referenced to the Ophthalmology consultation of the Oporto Hospital Center, through the ARS North screening program.	Porto- Portugal	Brazilian Journal of Ophthalmology
2017	Brazilian Society of Diabetes	Guidelines of the Brazilian Diabetes Society 2017-2018.	Follow the updates in the scientific knowledge of the area.	São Paulo-Brasil	Clannad Publisher, 2017.

Results

The searches in the VHL and databases through the pre-established descriptors, 32,882 articles were selected and the first filter was applied, after reading titles and abstracts 23,500 were discarded. After this withdrawal, 9,382 articles were discarded, however, after applying the second, third and fourth filters regarding inclusion and exclusion criteria and the search question, 9,368 articles were excluded, due to non-framing, including the elimination of 02 duplicate articles. Regarding the descriptor "Diabetic Retinopathy" there were a considerable number of findings (23,201), however most of the articles were not free, and when they were, they were in English or Spanish. The descriptor Teleophthalmology was the one that presented the least findings (17), because it was a subject still premature in scientific research, but we tried to analyze the publications to bring adherence of knowledge and enrich the review. The descriptor Diabetes Mellitus, on the other hand, stood out in terms of the number of findings (9,664) because it is a theme approached in agreement with several expectations, for example: nutrition, pathologies, nursing care, diabetic foot, insulin therapy, elderly public, drug toxicity, pressure injury, health education, among others.

Finally, the final sample counted with the use of 14 articles thoroughly analyzed, to support the research with evidence and compose the review.

Figure 1. Updated methodological scheme for the selection of articles on the use of Teleophthalmology as a screening for diabetic retinopathy (DR) in Basic Attention and the Comorbidities from DR.

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│    Studies identified from VHL and database searches │
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Databases: LILACS; SCIELO; MEDLINE.	Descriptors: Diabetes Melli- tus(23.201); Diabetic Retinopathy (9,664); Teleophthalmol- ogy(17).

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│              32,882 initial articles                 │
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Filter 1. Reading of titles and summaries.

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│      9,382 selected and 23,500 excluded articles     │
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Filter 2. Inclusion Criteria:
Chronicity between 2014-2019, except for the teleophthalmology descriptor;
Complete;
Free;
Available in full;
Portuguese language;
Comply with the topic of revision

Filter 3. Exclusion Criteria:
Duplicate articles;
That did not fit the inclusion criteria;
No answer to the research question.

Filter 4. Search Question:
"How important is the use of teleophthalmology to track diabetic retinopathy (DR) in Basic Care and what are the comorbidities coming from DR?

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┌─────────────────────────────────────────────────────┐
│       14 selected and 9,368 excluded articles        │
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┌─────────────────────────────────────────────────────┐
│                 14 final articles                    │
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Discussion

Regarding teleophthalmology in conjunction with teleretinography, it provides ways to optimize the time for diagnosis, helps to reduce the waiting queue, gain time for the treatment of pathologies identified through retinography examination. Teleretinography maximizes the excellence of Basic Health Care ophthalmology services, enabling quality of life and mapping of issues related especially to teleophthalmology [3,9]. The main evaluations and treatment through of teleophthalmology are in relation to RD, through the analysis of images obtained through portable retinal cameras in remote places. When compared with stereoscopic images of traditional film, those acquired by the retinograph found a concordance of 82.5%, whereas in the analysis of digital photographs of diabetic patients submitted via internet, they found 100% concordance for events with presence or absence of retinal detachment. There are reports in scientific studies that during research on the asynchronous method, it was extracted that this approach has become the "most efficient way", because it is the static images with higher quality and resolution when compared to images transmitted online, besides not needing all professionals present simultaneously.

The effective detection of DR by diagnostic examinations, in conjunction with teleophthalmology, provides a cost-effective representation, in addition to expanding the accessibility to DR diagnosis, in view of the imbalance between the supply and demand of specialists [10].

Primary Health Care (AB) is the first instance that the patient gets in touch with the health professional, it is known that the flow of patients for ophthalmologic evaluation begins with the physicians who act in this health sphere. In the case of Teleophthalmology, patients are referred through the Telehealth Electronic Platform [9], which performs interaction of emerging information and communication technology (Internet), to contribute in the improvement or provide health care [11,12], being the responsibility of the Telehealth team the scheduling in the remote unit, The evaluation of these patients is performed by telemedicine by the ophthalmologists and with the presence support of the nursing team providing full support and assistance during the exams in the remote office, in sequence the exam is evaluated by a specialist in the area of ophthalmology who lauds the material, making it available for immediate shipment to the requesting doctor, along with recommendations for conduct through the Platform itself [9].

The Brazilian Society of Diabetes demonstrates through epidemiological studies the importance of DR screening in basic care [1], as it provides an essential role for the prevention of blindness [2], in order to prevent patients from developing advanced DR complications [1].

Aiming at this speech, the Ministry of Health suggests as a strategy to track the DR in the basic health units of the SUS (Unified Health System), the referral to ophthalmological consultations of all patients who have the DM2, at the time of diagnosis, this model is offered only to people who seek the health unit for opportunism. For patients without DR, screening is offered annually in an individual context for those with retinal injury [4].

It becomes important the organization of a look directed to this specific public, in order to promote health accessibility, especially in the primary care setting. Such targeting would help foster programs that track DR in people with MD the risk of visual loss, and would give them the proper ophthalmological targeting, as well as the individuals that would be tracked and followed in basic care. The screening of DR aims to: detect cases early, enable treatment and care, provide decrease in the progression of DR, lower the number of referrals [4], and prevent such individuals from undergoing unnecessary procedures [1], improve and enhance the use of resources, and foster a better quality of life [4].

The gold standard diagnostic examination for retinal evaluation is the CSP (Color Stereoscopic Photography), which delivers adequate accuracy. The CSP is a three-dimensional (stereoscopic) imaging exam produced by a retinographer, requiring pupil dilatation that generates moments of discomfort to the patient, considering the number of photos, at least seven [4].

The most recurrent complications of diabetes are blindness suddenly linked to DR [2,4,5,6,7,13], especially in the population between 16 and 64 years of age [14], and severe visual acuity loss and [4] patients with DM have thirty times more possibility of blinding than non-diabetic patients, however this event can be reduced to 5% when the diagnosis is made early, providing timely treatment before irreversible changes can occur [2].

Conclusion

The use of teleophthalmology, although premature, deserves investment and improvement of its strategy, considering the benefits they add to the health and quality of life of patients with diagnosed DM, evolving to DR. The data examined brought clarity as to the empowerment of SUS, regarding early diagnosis and strengthening of information behind telemedicine. In the current health situation, patients need agile, reliable and effective care; especially in view of the large number of patients and the long wait for ophthalmologic exams, therefore, the use of teleophthalmology is opportune, aiming at improving and solving the problems regarding the screening of diabetic retinopathy in the basic sphere of health care.

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