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Tele-Endocrinology: Providing Endocrine Consultative Service Using Telemedicine

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ABSTRACT

Objective: To investigate the efficacy of a telemedicine-based endocrine consultative service in improving outcome measures in rural patients with endocrine disorders.

Materials and Methods: Patients from five rural communities were referred by their primary care providers (PCPs) to the Telemedicine Unit of the University of Tennessee Health Science Center (UTHSC). Patients and the telemedicine studio were connected via videoconference using Polycom VSX 7000 video cameras, television monitors and dedicated lines to transmit video and audio electronic records. Recommendations regarding management were sent to the PCP via fax. Data were summarized using mean and standard deviations for continuous variables, and percentages for categorical variables. Statistical analysis was performed using Student's t-test for continuous variables and Chi square test for categorical variables.

Results: Sixty-six patients aged 53.8 ± 15.5 years, 73 percent of whom were females, were seen over a three-year period. Of the 66 patients seen, 53 percent had type 2 diabetes while 45 percent and 41 percent had dyslipidemia and hypertension respectively; 30 percent were seen for thyroid disease and 12 percent had mineral or bone disease. Available data showed significant reduction in hemoglobin A1c after six months [9.1 ± 1.3 to 7.5 ± 1.4%; (P<0.002)] as well as improvement in mean lipid profile [total cholesterol (*P*=0.027), HDL (*P*=0.038) and triglyceride (P=0.046), with a trend towards reduction in LDL (P=0.085)]. Ninety-seven percent of subjects were comfortable with receiving care through telemedicine.

Conclusion: A telemedicine-based endocrine consultative service utilizing videoconference technology was effective in improving outcome measures in patients with diabetes and other endocrine disorders.

Abbreviations: PCP - Primary care providers; HbA1c - Hemoglobin A1c; HDL - High density lipoprotein cholesterol; LDL - Low density lipoprotein cholesterol

INTRODUCTION

The prevalence of diabetes and other endocrine diseases continues to escalate worldwide with an estimated 26 million people being affected by diabetes in the United States.[1] Rising prevalence of diabetes is particularly significant in rural areas of the U.S. where the prevalence is about 17 percent higher compared to urban centers.[2] This disparity is compounded by the lack of specialists in rural communities, which contributes to poor outcomes, especially in diabetic patients.[3] Diabetic complications are significantly ameliorated by optimal glycemic control and proper treatment of concomitant cardiovascular risk factors such as hypertension and dyslipidemia.[4-6] Previous studies investigating the utility of telemedicine in improving outcome measures in diabetic patients have obtained somewhat conflicting results.[7-9] However, in a previously reported study, we demonstrated that a program which provided diabetes self-management education via telemedicine was beneficial in improving outcome measures such as hemoglobin A1c and lipid profile.[10]

The World Health Organization defined telemedicine in 1998 as the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communications technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of advancing the health of individuals and their communities.[11] Telemedicine entails the transfer of electronic medical data

such as high resolution images, sound, video, and patient records to a remote location utilizing telecommunications technology like telephone, internet or satellites, and the delivery of remote health services using this technology. Provision of accessible and affordable care should improve the standard of care and outcome in patients with endocrine disorders especially diabetes. We hypothesized that bridging the gap in endocrine care in patients living in rural communities via telemedicine would improve outcome measures. Therefore, we investigated the efficacy of telemedicine-based endocrine consultative service in improving outcome measures in endocrine patients in rural communities.

METHODS

We conducted a retrospective analysis of patients who were seen at the Telemedicine Unit of the University of Tennessee Health Science Center, Memphis, TN, from September 2007-August 2010. Sixty-six patients from five rural communities in Tennessee (Somerville, Parsons, Savannah, Trenton and Dyersburg) were referred by their PCP to the Telemedicine Unit for various endocrine and related disorders. The patient and the endocrinologist were connected via videoconference, and were able to sustain clearly audible discussion to obtain medical history from the patient. Clinical evaluation was done by the endocrinologist by visual inspection using the camera and television screen. A nurse in the remote site facilitated the communication between the physician and the patient and also helped to perform some examination such as obtaining the vital signs of the patient, checking for thyromegaly and monofilament sensation in the feet of diabetic patients, under the watch of the endocrinologist. The studio and the remote sites were connected via videoconference using Polycom VSX 7000 video cameras (Pleasanton, CA 94588, USA), television monitors and dedicated lines to transmit video and audio electronic records. Recommendations regarding management were sent from the endocrinologist to PCP via fax. Laboratory evaluations were performed by the PCP as requested. The outcome measures were $HbA1_C$, blood pressure, lipid profile and thyroid function tests as indicated. Data were collected at initial visit and subsequently as necessary according to the standard of care for the disease entity in consideration. Patients did not return for follow-up after initial consultation with the endocrinologist if their PCP was comfortable with continuing their care. A questionnaire was administered at the end of each visit to determine if the patients were comfortable with the visit and if they would use it again if need be. The Institutional Review Board of the University of Tennessee Health Science Center approved the study.

RESULTS

Sixty-six patients aged 53.8 ± 15.5 years, 73 percent of whom were females were seen over three years. Of the 66 patients, 35 (53 percent) had type 2 diabetes, two (three percent) had type 1 diabetes, two (three percent) patients were known to have prediabetes, 27 (41 percent) had hypertension, while 30 (45 percent) had dyslipidemia; 20 (30 percent) had thyroid disease, and 8 (12 percent) had osteoporosis or hypercalcemia. Other reasons for endocrinology consultations included hyponatremia and polycystic ovarian syndrome. Some patients had more than one endocrine disorder. Table 1 shows the baseline characteristics of patients.

Outcome Measures (see Table 2):

1. Hb A1c – Follow-up data was available for 20 of the 35 diabetic patients seen with Type 2 diabetes. Mean duration of diabetes for these subjects was 10 years ± 8.5. Significant improvement in Hb A1c was seen in 17 (85 percent) of these patients. After an average

follow up of 6 months, glycosylated hemoglobin decreased from 9.1 ± 1.3 at presentation to 7.5 ± 1.4%; (P < 0.002) See Figure 1.

2. Thyroid Function Tests - Follow-up data were available in four patients with thyroid disease, all of whom had become euthyroid. Majority of the patients with thyroid dysfunction did not return for follow up because the referring providers were comfortable with their management after the initial consultation.
3. Lipid Profile - 12 (70%) of 17 subjects with dyslipidemia who had available follow-up data showed improvement in lipid profile. Mean total cholesterol decreased from 210 ± 69 to 184 ± 52 (*P*=0.027), HDL cholesterol from 42 ± 11 to 46 ± 11 (*P*=0.038) and triglyceride from 414 ± 203 to 182 ± 153 (P=0.046). There was a trend towards reduction in LDL cholesterol 118± 56 to 100 ± 38 which did not reach statistical significance (*P*=0.085) probably due to small numbers [some patients had high triglyceride levels (>400mg/dl), therefore, LDL could not be calculated].
4. Blood Pressure - Systolic blood pressure was 135 ± 22 mmHg at presentation and remained stable 132± 22 mmHg (p=0.224), while diastolic blood pressure exhibited a trend towards reduction at 6 months 75 ± 11 to 72 ± 12(P=0.05). Subjects on the average had relatively good blood pressure control.
5. Acceptability - Nearly all patients (97 percent) were comfortable with receiving care from a remote site through videoconference.

DISCUSSION

The use of telemedicine was investigated by Einthoven, the father of electrocardiography in 1906 when he tested the transmission of electrocardiograms over telephone lines.[12] This concept of transmitting medical data through information technology has spread rapidly in later part of the 20th century and is currently being utilized for extending heath care to rural populations. The findings of our study demonstrate that a telemedicine based program providing endocrine consultation using videoconference technology is effective in improving outcome measures in diabetes and its co-morbid conditions as well as other endocrine disorders. Our current report is consistent with an earlier one, which showed the improvement in HbA1c and cardiovascular risk factors in diabetic patients who were given diabetes self-management education via telemedicine.[10] Earlier studies on telecare for patients with type 1 diabetes mellitus, which provided feedback to patient's transmission of self-monitored blood glucose in addition to quarterly face to face contact had beneficial impact on glycemic control.[13]

When used in lieu of clinic visits, telecare in type 1 diabetes was shown to be comparable in terms of glycemic control and the incidence of acute diabetes related complications and may be potentially cost saving.[8] Feedback given through telemedicine to data transmitted from continuous glucose monitoring devices and insulin pump in type 1 diabetic patients with near goal glycemic control showed further improvement in HbA1c, less variability in glucose excursions and reduced fear of hypoglycemic events.[14] These findings were in accordance with another study of type 1 diabetic patients, which observed a trend towards improvement in HbA1c without an increase in the incidence of hypoglycemia by using a telemedicine approach.[15] Some studies on the other hand have failed to demonstrate any benefit of telemedicine on outcome measures compared to control or standard care.[9]

In general, the studies mentioned above support the hypothesis that this technology is effective in delivering medical care. However, limited work has been done to assess the utility of telemedicine in the underserved population. Our study demonstrates that telemedicine can have a significant impact in bridging the gap in health care created by the increasing disease burden and lack of specialists in rural or underprivileged regions. The observation that many

patients had achieved target blood pressure and lipid levels at baseline is consistent with the report of other studies indicating that glycemic control is the most challenging to attain in patients with multiple cardiovascular risk factors.[6] Therefore, the degree of reduction in HbA1c recorded in this study is impressive, especially when considering that our patients had diabetes for an average duration of 10 years. It could be anticipated that the control of multiple cardiovascular risk factors, including hyperglycemia, dyslipidemia and hypertension, achieved in this study would lead to reduction in overall cardiovascular morbidity and mortality.[6] This generates a hypothesis that should be tested using a randomized controlled prospective study of telemedicine methods in a cohort of rural dwellers. The cost effectiveness of various telemedicine applications should also be determined. It is noteworthy that this study is limited by the small sample size, brief follow-up period and incomplete data in subjects who did not return for follow-up.

CONCLUSION

Telemedicine proved to be an acceptable means of providing effective, affordable and accessible care in this cohort of endocrine patients. The potential growth of this strategy for effective control of diabetes with reduced need for face-to-face encounter time appears to be a promising solution. Further prospective studies would be required to validate the findings of this pilot project and to assess the generalizability of this emerging technology in a wider population.

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Table 1. Baseline characteristics of Telemedicine Clinic patients.	
Number of patients (n)	66
Females	48
Males	18
Type 2 Diabetes Mellitus	35 (53%)
Type 1 Diabetes Mellitus	2 (3%)
Prediabetes	2 (3%)
Hypertension	27 (41%)
Hyperlipidemia	30 (45%)
Thyroid dysfunction	20 (30%)
Bone and Mineral Disorder	8 (12%)

Table 2. Comparison in mean lipid levels and blood pressure.

	Baseline	**Follow-up**	**p-Value**
LDL	118 ± 56	100±38	0.085
HDL	42±11	46±11	0.038
Cholesterol	210±69	184±52	0.027
Triglyceride	414±203	182±153	0.046

SBP	135±22	132±22	0.224
DBP	75±11	72±12	0.05

Figure. Comparison of HbA1C at baseline and 6 months.