Original Article

The use of telemedicine in the preoperative management of pheochromocytoma saves resources

Martin Joseph Heslin[1], Joe-Spencer Liles[1], Paulina Moctezuma-Velázquez[2]

[1]Division of Surgical Oncology, Department of Surgery, University of Alabama at Birmingham (UAB), Birmingham, AL, USA; [2]Nacional Institute of Medical Sciences and Nutrition Salvador Zubirán, Tlalpan, Mexico City, México

Contributions: (I) Conception and design: MJ Heslin, JS Liles; (II) Administrative support: UAB Hospital; (III) Provision of study materials or patients: MJ Heslin; (IV) Collection and assembly of data: JS Liles, P Moctezuma-Velázquez; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Paulina Moctezuma-Velázquez. Nacional Institute of Medical Sciences and Nutrition Salvador Zubirán, Vasco de Quiroga No. 14, Colonia Sección 16, Tlalpan, CP14080, Mexico City, México. Email: camila.mocv@gmail.com.

Background: Surgical management of pheochromocytomas involves appropriate pre-operative alpha blockade. This process often results in multiple clinic visits, substantial delay in resection, and use of limited resources. We sought to evaluate the benefit of patient participation and doctor-patient telecommunication in pre-operative alpha blockade.

Methods: A "study group" of patients, retrospectively collected, with pheochromocytoma requiring alpha-blockade therapy, during their initial clinic visit were educated on the use of a sphygmomanometer and the accurate detection of orthostatic blood pressure (BP). Subsequently, orthostatic evaluation and dose escalation were conducted through e-mail correspondence between the patient and the surgeon on a biweekly basis. This group of patients was compared with an historical "control group" consisting of 14 patients, whose preoperative treatment was titrated during clinic visits.

Results: The two groups were similar in terms of operation performed (laparoscopic versus open), estimated blood loss, tumor size, and post-operative length of stay. Active patient participation in pre-operative alpha blockade therapy resulted in significantly fewer preoperative visits (mean 1.52 *vs.* 3.20 visits; P=0.02) and a significantly shorter time from initiation of blockade to resection (33 *vs.* 82 days; P=0.03).

Conclusions: Titration of alpha blockade therapy through patient and surgeon e-mail correspondence is efficacious and saves limited resources and time. This process eliminates unnecessary travel time and expenses for the patient. Due to the benefits of telemedicine for pheochromocytoma preoperative care, our method should be implemented in the routine surgical care of pheochromocytomas.

Keywords: Preoperative care; pheochromocytoma; alpha blockers; telemedicine

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Introduction

Pheochromocytomas are rare tumors of neuroectodermal origin. They most frequently arise from the adrenal medulla as functional tumors secreting catecholamines (norepinephrine, epinephrine, and dopamine) (1). Signs and symptoms are related to the effect of circulating catecholamines and include headaches, tachycardia, hypertension, palpitations and anxiety (2). Chronic alpha-adrenergic stimulation results in vasoconstriction and diminished plasma volume leading to cardiovascular sequelae including myocardial infarction, cardiomyopathy, cardiac dysrhythmias, and stroke (3).

Surgical resection is the appropriate treatment of pheochromocytoma but requires preoperative alpha-adrenergic blockade to minimize the risk of perioperative cardiovascular complications (4). While some studies

question the required use of preoperative pharmacological preparation, especially in normotensive pheochromocytomas, it is widely-accepted that pre-operative alpha blockade is necessary (5). Alpha blockade prevents unopposed alpha-adrenergic stimulation resulting in vasodilation and associated intravascular volume depletion (3). Volume expansion is recommended through preoperative hydration and the adherence to a high sodium diet (6).

Historically, patients required preoperative hospitalization with aggressive titration of alpha-antagonists and saline infusion for several weeks (7). Due to multiple orally-available alpha-antagonists, outpatient preoperative alpha-blockade is the current standard of care (8). Although a great improvement, this plan requires frequent dose titration and multiple preoperative visits to assess for orthostatic hypotension, measuring blood pressure (BP) and heart rate (HR) as well as monitoring pharmacologic side effects.

Here, we hypothesize that pre-operative telecommunication between patients and physicians for the preparation of resection of pheochromocytomas is a safe and effective method of significantly reducing preoperative clinic visits and time to surgical resection while conserving limited medical resources.

In surgical care, telemedicine has been more commonly used for postoperative purposes, such as monitoring surgical drain output for breast surgery via text messaging (9). Even more, newer technology devices like smartphone apps have been used in order to improve treatment adherence and BP monitoring in post transplanted kidney patients (10). Video conferences have been used to evaluate urologic postoperative outcomes in children (11), or ileostomy outputs after discharge (12), through this channel physicians may immediately suggest therapeutic actions to improve patient´s conditions.

Other information that may be exchanged by telemedicine resources are videos or photos, so surgeons have been able to evaluate patient´s abdominal wounds after appendectomy (13) or neck wounds after parathyroidectomy (9) without face-to-face consultation.

Telemedicine in surgical preoperative assessment or diagnosis has already been described, although it has been more widely applied for post-operative follow up. For preoperative management, a group of pediatric surgeons (14), used a telephone-based videoconference, preoperative assessment occurred in 32.8% of their patients which included any required preoperative teaching of the family.

For preoperative diagnosis and assessment, telemedicine has proven to be safe and effective in different types of surgery; for maxillofacial surgery (15), surgical trauma (11) for plastic surgeon evaluation in a military facility (9), neonatal surgical consultation for diagnosis and operative plan if needed (16), preoperative bariatric surgery consultations (17) prescreening of possible surgical patients of remote areas (18).

Methods

A retrospective review of surgically managed pheochromocytomas by a single surgeon at our institution was performed, 14 patients who were treated preoperatively with frequent clinic appointments for orthostatic evaluation and alpha-blockade dose titration were considered as the "control group".

Usually, the patients in preoperative alpha blockade are who asks them to sit down for at least five minutes, then their BP and HR are evaluated while seated and in standing position. Their BP and HR are registered at their medical records, the targeted BP is <130/80 mmHg while seated and a systolic BP greater than 90 mmHg while standing, with a target HR of 60–70 bpm seated and 70–80 bpm standing (3). Afterwards the surgeon checks the medical files and asks for data of orthostatic hypotension, such as lightheadedness or dizziness when standing up, if treatment titration is needed the physician makes the appropriate changes. As soon as they reach the targeted measures, surgery is scheduled.

The patients known as the "study group" were another 14 patients with diagnosed pheochromocytoma who were not available for weekly clinic visits, so at their first clinical appointment they were educated by a nurse on the use of a sphygmomanometer, HR measurement and the accurate detection of orthostatic hypotension (19), they were given a prescription for alpha-blockade agent and written instructions that specified the e-mail address, the information they must provide in each e-mail and the days of the week they should be writing (Monday and Friday until 8 pm). Subsequently, the surgeon, on a biweekly basis, revised and replied the e-mails and if needed, dose escalation was appointed. When the patients reached the targeted BP and HR, they were asked to come by the clinic to schedule for surgery.

Afterwards the comparison between groups were performed using a *t*-test or a chi-square test as appropriate, using the SPSS software version 19.0, and the statistical significance was defined at the level of $P<0.05$.

Ethics approval was not required as data in this study was collected prior to the need for IRB approval for

Table 1 Patient demographics and operative characteristics

Variable	Study, n [%]	Control, n [%]	P
Age, years			NS
≤55	8 [57]	7 [50]	
>55	6 [43]	7 [50]	
Sex			NS
Male	5 [36]	6 [43]	
Female	9 [64]	8 [57]	
Race			NS
Caucasian	9 [64]	7 [50]	
African American	4 [29]	6 [43]	
Other	1 [7]	1 [7]	
Tumor size, cm			NS
≤6	10 [71]	10 [71]	
>6	4 [29]	4 [29]	
Mean	5.5	4.72	

NS, no significant.

Table 2 Endpoints

Variables	Study (n=14)	Control (n=14)	P
Operation, n [%]			
MIS	12 [86]	13 [92]	NS
Open	2 [14]	1 [7]	NS
Complications	1 [7]	2 [14]	NS
Blood loss (mean, cc)	198.5	241.4	NS
Length of stay (mean, days)	2.35	2.28	NS
Number of pre-operative visits (mean, visits)	1.52	3.20	0.02*
Time from initiation of blockade to resection (mean, days)	33	82	0.03*

*, statistically significant. NS, no significant.

retrospective studies at our institution.

Results

Twenty-eight patients were included, the two groups were similar in terms of age, sex, race, and tumor size (*Table 1*). Perioperative characteristics (*Table 2*) such as estimated blood loss, type of surgery (laparoscopic or open) and complications were also similar, active patient participation in pre-operative alpha blockade therapy resulted in significantly fewer preoperative visits (mean 1.52 *vs.* 3.20 visits; P=0.02) (*Figure 1*) as well as in a significantly shorter time from initiation of blockade to resection (33 *vs.* 82 days; P=0.03). Two patients had their surgeries postponed due to inadequate control upon arrival to the hospital the day of surgery (one in each group) so they were not considered in the analysis.

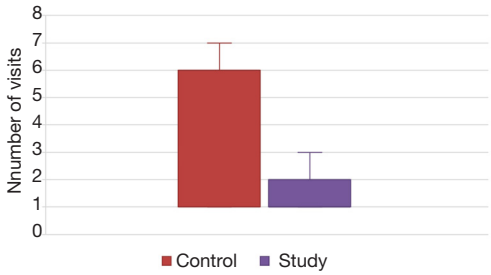

Figure 1 Box plot of number of visits for preoperative management. Patients in study group had a median of only mean of 1.52 preoperative visits compared with 3.20 visits for patients in control group.

Discussion

Telemedicine in surgery has become a useful tool for patient care delivery although it is not accessible to all the patients or health providers (20).

In this example, titration of alpha blockade therapy through patient and surgeon e-mail correspondence is efficacious as well as safe and it saves limited resources and time. It also allows patients to prepare for surgery in a non-hospital environment and less working days lost. Because pheochromocytomas are frequently treated at distant tertiary referral centers, this process eliminates unnecessary travel time and expenses for the patient, preserving its quality of life. Furthermore, it has already been identified that the total in-hospital cost for patients with pheochromocytoma is approximately $50,000 compared with $41,000 for other adrenal masses (21).

Assessment of BP and HR as an outpatient was described by Witteles *et al.* (7), before 1987, patients with pheochromocytoma were hospitalized for preoperative treatment. The authors compared the costs of preoperative

treatment of patients as outpatients *vs.* hospitalized. In this scenario the outpatients made a phone call to their anesthesiologist who would adjust their medication as needed, no information about preoperative clinic visits is given but preoperative hospital stay in this group was significantly shorter than in inpatients (3.27 *vs.* 12.82 days, P=0.002). No other reference in the literature was found about this kind of action.

The costs of telemedicine have not been widely analyzed, though it is known that it saves patients' and hospitals' resources. It also provides a mean of communication between physicians to exchange knowledge, information and advice in real time scenarios. Telemedicine has even been used to mentor surgical procedures. We should try to widen the field of preoperative management, some of the future perspectives should focus on photographic assessment of a wound bed for skin grafting, follow up of a kidney stone with serial X-rays sent to the doctor, if it fails to be expulsed, schedule a procedure. Anesthesiologist may also benefit from telemedicine to follow-up comorbid conditions that should be controlled before a surgical procedure such as tobacco use, glycemic control, anemia, obesity.

Conclusions

Due to these benefits, compared with usual care, this e-mail based pre-operative management should be implemented in the routine surgical care of pheochromocytomas, as it diminished preoperative visits and the mean time since initiation of management to surgery. Technology is nowadays an important tool for our society, doctors need to be encouraged to use telemedicine as part of its daily practice as long as it is safe and satisfying for the patient.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Ethics approval was not required as data in this study was collected prior to the need for IRB approval for retrospective studies at our institution.

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