Published in final edited form as:

Clin Endocrinol (Oxf). 2014 June ; 80(6): 863–868. doi:10.1111/cen.12375.

Impulse control disorders in patients with dopamine agonist-treated prolactinomas and non-functioning pituitary adenomas: a case-control study

Irina Bancos, MD¹, Michael R. Nannenga, MD², J. Michael Bostwick, MD³, Michael H. Silber, MB, ChB⁴, Dana Erickson, MD¹, and Todd B. Nippoldt, MD¹

¹Division of Endocrinology, Department of Medicine, Mayo Clinic, Rochester, MN

²Division of Endocrinology, Holston Medical Group, Kingsport, TN

³Department of Psychiatry, Mayo Clinic, Rochester, MN

⁴Department of Neurology, Mayo Clinic, Rochester, MN

Abstract

Objective—We aimed to assess the prevalence of impulse control disorders (ICDs) in patients with prolactin-secreting adenomas treated with dopamine agonists (DAs), to identify associated factors, and compare it with a group of patients with non-functioning pituitary adenoma.

Subjects, Design and Measurement—In a postal survey, 77 patients from Group A (patients with prolactinomas and present or past use of DAs) and 70 patients from Group B (patients with non-functioning pituitary adenoma and no history of DA therapy) responded to a questionnaire on compulsive shopping, pathologic gambling, hypersexuality and punning. Associated clinical information was obtained through the survey and review of medical electronic records.

Results—The total ICD prevalence was 24.68% in Group A and 17.1% in Group B ($p=0.31$). Group A had an increased rate of hypersexuality ($p=0.03$). Subgroup analysis revealed that men in Group A had a significantly increased frequency of total ICDs when compared to men in Group B (27.7% versus 3.7%, $p=0.01$). No differences in rates of total ICDs were found between women of Groups A and B (20% versus 25.6%, $p=0.78$). No association with type, dose, or duration of treatment with DA was noted.

Conclusions—Males with prolactinomas treated with DAs were 9.9 times more likely to develop an ICD than their counterparts with non-functioning pituitary adenomas. Until prospective studies on the relationship of DA use in prolactinoma patients and ICDs are available, the authors propose that prolactinoma patients be forewarned of possible ICD development with DA therapy.

Correspondence: Irina Bancos, MD, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, Phone: (507) 284-2511, Fax: (507) 284-5745, bancos.irina@mayo.edu.

Conflict of Interest

IB, MRN, JMB, MHS, DE, TBN have nothing to declare.

Financial Disclosure

This publication was supported by Grant Number UL1 TR000135 from the National Center for Advancing Translational Sciences (NCATS). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

Keywords

ICD; prolactinoma; dopamine agonist

INTRODUCTION

An increased frequency of impulse control disorders (ICDs) has been widely reported with the use of dopaminergic agents in a subset of patients with Parkinson's disease (PD) and restless leg syndrome (RLS). Recognized ICDs in these settings include pathologic gambling,¹⁻⁵ hypersexuality,⁴⁻⁷ compulsive shopping,^{4, 7} compulsive eating,⁸ and punding*.⁹⁻¹¹ The occurrences of these ICDs may possibly be due to overstimulation of mesolimbic dopamine receptors in the central dopaminergic reward system.^{12, 13}

The relationship between ICDs and the use of dopaminergic medications in patients with prolactin-secreting pituitary tumours has not been clearly established. Indeed, the doses of dopamine agonists (DAs) used in these instances are considerably smaller (5 to 10 times) than those used to treat PD or RLS. Several reports have been published in the literature of ICDs occurring in the setting of DA therapy for prolactinomas; many with devastating consequences to the patients.¹⁴⁻¹⁶ In a series of 20 patients with prolactinomas on DA therapy, 2 (10%) were reported to have ICDs.¹⁷ Although treatment with dopaminergic agents can last a lifetime, the frequency of ICDs in prolactinomas, and the association with dose and type of dopaminergic medication, are yet unknown.

The objectives of this study were to assess the frequency of ICDs in patients with prolactin-secreting adenomas treated with DAs, identify associated factors, and compare the findings with a group of patients diagnosed with non-functioning pituitary adenoma.

MATERIALS AND METHODS

Patients and controls

Subjects were categorized into two groups: Group A consisted of patients diagnosed with prolactin-secreting pituitary adenoma with present, or past, use of DAs; in Group B (also known as the control group) patients had been diagnosed with a non-functioning pituitary adenoma with no history of DA therapy. Exclusion criteria were inability to complete a questionnaire, history of DA use for disorders other than prolactinoma, or a clearly documented pre-existing ICD. Patients were identified retrospectively based on the screening of all endocrine visits from January 1 2001 through December 31, 2011 at Mayo Clinic, Rochester, MN. A database consisting of 400 subjects in each group were initially screened for eligibility and surveys were sent to 200 consecutive patients with the most recent visits. Demographic information, medical information pertaining to pituitary tumour history and treatment, and history of psychiatric disorders were obtained both from the electronic medical record and confirmed through the completed questionnaire(s). This study

*Urban Dictionary Definition: "Punding is human activity characterized by compulsive fascination with and performance of repetitive, mechanical tasks, such as assembling and disassembling, collecting, or sorting household objects."

was approved by the Mayo Clinic Institutional Review Board and only subjects who had given a written informed consent were included in the study.

Study Design

The study was a cross-sectional, observational study.

ICD questionnaires

The four-part questionnaire used in this study was based on screening tools that had been used in previous studies of ICDs in PD and RLS.^{4, 7, 9, 18} The questionnaire can be viewed in Supplement 1.

1. A modified hypersexuality questionnaire. Positive screen was defined as *yes* to question #1 and a total score of ≥ 2 . (Supplement 1, item 9)
2. The Minnesota Impulse Disorders Interview, used to determine compulsive shopping. Positive screen was defined as total score of ≥ 9 . (Supplement 1, items 10–28)
3. A modified version of the South Oaks Gambling Screen. Positive screen was defined as *yes* to question #1 and a total score of ≥ 5 . (Supplement 1, item 29)
4. A modified punting questionnaire. Positive screen was defined as a total score of ≥ 4 . (Supplement 1, item 30)

Telephone Interviews

To explore the possible relationship to DAs in more detail, we attempted to contact by phone all subjects who had positive results on any of the screening questions. All interviews were performed by one investigator (IB) and consisted of 3 parts: 1) Confirmation of positive answers to the survey; 2) Confirmation that symptoms occurred while on DA therapy (for Group A only); 3) Discussion of symptoms in detail, of a possible relationship of symptoms to the DA therapy and offer to schedule a follow up visit with patient's endocrinologist. A standardized follow up letter was sent to all patients who provided a telephone interview.

Statistical analysis

As prevalence of ICDs in prolactinomas treated with DAs was unknown, we chose to perform a survey screen using Group A's results from the ICD questionnaires first. Subsequently, we used this information, as well as observed response rates, to determine the required sample size for both groups using the following calculation: A two-group continuity-corrected χ^2 test with a 0.050 two-sided significance level will have 80% power to detect the difference between a Group A proportion, π_1 , of 0.240 and a Group B proportion, π_2 , of 0.060 (odds ratio of 0.202) when the sample size in each group is 72. Data are reported as medians (ranges) or means (SD), based on observed distributions. We used the Fisher's Exact Test and unpaired t-tests for categorical and continuous variables, respectively, for comparison between Groups A and B. We considered differences significant at $p < 0.05$. Results were analyzed using JMP software, version 9.

RESULTS

All survey recipients

After electronic medical record screening for eligibility criteria, surveys were sent to 200 patients with prolactinoma and 200 patients diagnosed with non-functioning pituitary adenoma. The cohort of patients with non-functioning pituitary adenoma selected for mail-in survey had a higher percentage of women in comparison to patients with prolactinoma (64% versus 55%, $p=0.0004$), but no difference in mean age ($p=0.07$) or percentage of responders ($p=0.6$). (Table 1). Within the groups, the response rates were not different between men and women (Group A $p=0.14$, Group B $p=0.98$), however, responders were older than non-responders women (Group A $p=0.006$, Group B $p=0.04$). (Table 2)

Survey responders

After sending 200 surveys to each group, 79 subjects in Group A (39.5%) and 76 subjects in Group B (38%) returned completed surveys. As two patients in Group A and five patients in Group B had not returned the accompanying consent form, they were not included in the study. In addition, one patient from Group B was identified as having a diagnosis of acromegaly upon chart screening and was excluded from analysis. Thus, 77 patients from the prolactinoma group and 70 patients from non-functioning pituitary tumour group were analyzed.

Table 3 presents basic demographic and clinical data of the study subjects. When compared to the control group, the proportion of males was higher in Group A (61% versus 39%, $p=0.008$). There were no differences in age, size of tumour on the last imaging study, prevalence of underlying psychiatric disorders or history of pituitary surgery. More patients suffered from associated appropriately treated central hypogonadism in the Group A (32% versus 14%, $p=0.01$), however the percentage of other pituitary hormonal deficiencies was similar in Groups A and B.

Patients with prolactin-secreting adenomas (Group A) were diagnosed at least 12 months prior to participating in the study. All had a history of current or past treatment with DAs for a median time of 94 months (ranges 5 – 455 months). At the time of survey completion, 22 subjects (29%) were on bromocriptine, 41 (53%) on cabergoline and 14 (18%) were not currently being treated with a DA. Median weekly dose was 1 mg (ranges 0.25 – 4mg) for cabergoline and 26.25 mg (ranges 8.75 – 70 mg) for bromocriptine.

The frequency of one or more ICDs in Group A was 24.68%. There was no relationship between the duration of treatment ($p=0.83$) or type of DA used ($p=0.33$) and associated ICD, based on survey threshold. In group A, there was no relationship to sex ($p=0.59$), tumour size at diagnosis ($p=0.1$), tumour size at the last imaging follow up ($p=0.29$) or to the shrinkage of the tumour ($p=0.3$). The total of positive answers to ICD questions was inversely related to subjects' age in Group A ($p=0.008$) however age was not associated with reaching a threshold for a positive ICD screen ($p=0.13$). History of pituitary insufficiency, pituitary surgery or psychiatric disorders were not associated with development of ICD positive screen ($p=0.17$, 0.57 and 0.77).

The frequency of one or more ICDs in Group B was 17.14%. Women had higher prevalence of positive ICD screen when compared to men (25.6% versus 3.7%, $p=0.02$). Age ($p=0.57$), tumour size ($p=0.89$), pituitary insufficiency ($p=0.11$), pituitary surgery ($p=0.29$) or psychiatric disorders ($p=0.09$) were not associated with ICD screen positivity.

When compared to Group B, Group A had an increased rate of hypersexuality (12.99% versus 2.86%, $p=0.03$); frequency of other ICDs was otherwise similar (Table 4). Individual data of Group A patients who developed hypersexuality are illustrated in Table 5. Out of 10 patients in group A who had an ICD screen positive for hypersexuality (Table 5), only 1 had hypogonadism and was on intramuscular testosterone injections every 2 weeks with (mid-injection total testosterone level of 265 ng/dl (240–950 ng/dL). Out of 10 patients in group B who had hypogonadism (appropriately treated), none developed hypersexuality.

Due to the significant difference in sex distribution between the two groups, a separate subgroup analysis was performed on men and women. Men in Group A had a significantly increased frequency of ICDs when compared to men in Group B (27.7% versus 3.7%, $p=0.01$). No differences in rates of total ICDs were found between women of Groups A and B (20% versus 25.6%, $p=0.78$).

Of the 31 subjects with a positive ICD screen 23 (74.2%), including 18 of the 19 positive-screened patients in Group A, were able to be reached for a phone interview and the results were confirmed in all. Six patients had already been off DAs at the time of interview, and eight patients planned to discuss lowering the dose and/or other therapeutic options with their endocrinologist. The interviews indicated that perceived intensity of symptoms varied between patients. For example, we discovered that one subject who developed an excessive gambling habit stopped his DA without physician advice several months prior to receiving the survey due to suspicion that this was medication related. He reported that his urge to gamble disappeared gradually in 4–6 weeks. Due to the high level of personal and financial distress his excessive gambling caused, the patient would not consider a DA therapy trial, and was considering other therapeutic options with his physician. Two subjects with newly developed hypersexuality after DA initiation confirmed that symptoms led to promiscuity, financial losses (in both cases) and loss of job (one case); however both had declined reconsideration of therapy at the time of discussion. In another two cases, while confirming positive answers on the ICD screen, patients denied any personal difficulties and could not confirm any temporal relationship of their ICD symptoms to DAs.

Discussion

In this cross-sectional observational study, we found that 24.6% of patients with DA-treated prolactinomas and 17.14% of patients with non-functioning pituitary tumours without history of DA treatment had a positive ICD screen assessment for hypersexuality, punting, or pathologic impulses to shop or gamble. For comparison, in a study using similar questionnaires assessing for hypersexuality, punting and pathologic impulse to shop or gamble, a frequency of 13% and 12%, respectively, was found in cohorts of patients with obstructive sleep apnea and RLS not treated with DA (the control groups).¹⁹ The prevalence of ICDs in the general population of Sao Paulo, Brazil has been reported to be 8.4%.²⁰

We found no relationship to the type of DA, duration of treatment, or dose in our prolactinoma cohort, although a significant proportion of DA-treated patients were on relatively low doses of cabergoline. Pathologic hypersexuality was the predominant ICD encountered in our DA-treated prolactinoma patients and was significantly increased in comparison to the control group (12.99% versus 2.87%, $p=0.03$). Associated clinical factors, including the size of tumour, and psychiatric disorders were not different between the groups. It is important to note that although Group A had more patients with hypogonadism than Group B, only 4 patients who had a positive ICD screen in Group A were taking testosterone replacement. Of these, the only person who developed hypersexuality had low-normal total testosterone levels (265 ng/dl). Thus, it is unlikely that supraphysiological androgen levels caused the symptoms. Overall, there was no statistically significant difference between the rates of positive ICD screening of Group A versus Group B. However, Group A had a predominance of males, and subgroup analysis showed that males in Group A had significantly higher frequencies of ICDs when compared to Group B (27.7% versus 3.7%). On the other hand, while there was a high rate of positive ICD screenings in women from both Group A and Group B (20% and 27%, respectively), there was no statistical difference between the women in the two groups. It is unclear as to the reason of female predominance of ICDs in Group B and further studies with larger cohorts are needed to confirm high rates of female ICDs in patients with pituitary tumours. Although a disparity in sex distribution between Groups A and B explains some of our results, it is possible that having a pituitary tumour in itself would predispose one to having an ICD. Indeed, our observed prevalence of ICDs among patients with non-functioning pituitary adenomas was higher than that found in a previously reported cohort of patients with obstructive sleep apnea and RLS. Furthermore, there is some data to suggest that patients with non-functioning pituitary adenomas and prolactinomas have a different personality profile when compared to healthy controls.²¹

To-date, this is the largest study on frequency of ICDs in patients with prolactinomas investigating the role of DA therapy and other clinical factors. Our study benefits from use of a control group of non-functioning pituitary tumours of the same size not treated with DA. Other strengths include the use of validated and/or previously published screening instruments and assessment for possible associated demographic and clinical factors. As a part of the protocol, we attempted to discuss and confirm the findings with participants over the phone. In our study, the response rate was approximately 39% in both groups. A previous study of ICDs in patients with RLS reported a 17.3% response rate.²² Based on the work of Beebe, et. al.²³ using a mixed-mode, mail and telephone, method an overall response rate of 49% would be expected for medical surveys. We were not surprised at the comparatively low response rate due to the sensitive nature of the inquired information. In addition, the accuracy of the current addresses could not be verified and was based on records during the patients' last visit at our institution. It was also unclear whether any of the circumstances, such as the patients' ability to understand and complete the surveys, changed since their last available clinical assessment. Based on a similar study in patients with RLS,²⁴ it is possible that those who experienced behavioral changes were more likely to respond, possibly resulting in an overestimation of the ICD prevalence in both groups. Another limitation of the study is a relatively atypical nature of the surveyed prolactinoma

patients, such as male prevalence, mean tumour size >10 mm and history of pituitary surgery in 27% of responders. This is likely due to referral bias.

In conclusion, we have defined the prevalence of ICDs in both prolactin-secreting tumours treated with DA and non-functioning pituitary tumours, and introduced the possibility that pituitary tumours themselves may contribute an additional independent risk for ICD development. Pathologic hypersexuality was noted at a significantly higher frequency in DA-treated prolactinoma patients, and males appeared to be particularly susceptible: males with prolactinomas treated with DA were 9.9 times more likely to develop an ICD than their counterparts with non-functioning pituitary adenomas. Although the prevalence of a positive ICD screen in women was higher than established norms in both groups, there was no difference between groups. No association with type, dose, or duration of treatment with DA was noted in this study. Until prospective studies on the relationship of DA use in prolactinoma patients and ICDs are available, the authors propose that prolactinoma patients be forewarned of possible ICD development with DA therapy at the initial and subsequent visits.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Driver-Dunckley ED, Samanta J, Stacy M. Pathological gambling associated with dopamine agonist therapy in Parkinson's disease. *Neurology*. 2003; 61:422–423. [PubMed: 12913220]
2. Molina JA, Sáinz-Artiga MJ, Fraile A, et al. Pathologic gambling in Parkinson's disease: a behavioral manifestation of pharmacologic treatment? *Mov Disord*. 2000; 15:869–872. [PubMed: 11009192]
3. Voon V, Hassan K, Zurowski M, et al. Prospective prevalence of pathologic gambling and medication association in Parkinson's disease. *Neurology*. 2006; 66:1750–1752. [PubMed: 16769956]
4. Weintraub D, Siderowf AD, Potenza MN, et al. Association of dopamine agonist use with impulse control disorders in Parkinson disease. *Arch Neurol*. 2006; 63:969–973. [PubMed: 16831966]
5. Bostwick JM, Hecksel KA, Stevens SR, et al. Frequency of new-onset pathologic compulsive gambling or hypersexuality after drug treatment of idiopathic Parkinson disease. *Mayo Clin Proc*. 2009; 84:310–316. [PubMed: 19339647]
6. Klos KJ, Bowers JH, Josephs KA, et al. Pathological hypersexuality predominantly linked to adjuvant dopamine agonist therapy in Parkinson's disease and multiple system atrophy. *Parkinsonism Relat Disord*. 2005; 11:381–386. [PubMed: 16109498]
7. Voon V, Hassan K, Zurowski M, et al. Prevalence of repetitive and reward-seeking behaviors in Parkinson disease. *Neurology*. 2006; 67:1254–1257. [PubMed: 16957130]
8. Nirenberg MJ, Waters C. Compulsive eating and weight gain related to dopamine agonist use. *Mov Disord*. 2006; 21:524–529. [PubMed: 16261618]
9. Evans AH, Katzenschlager R, Paviour D, et al. Punding in Parkinson's disease: its relation to the dopamine dysregulation syndrome. *Mov Disord*. 2004; 19:397–405. [PubMed: 15077237]
10. O'Sullivan SS, Evans AH, Lees AJ. Punding in Parkinson's disease. *Pract Neurol*. 2007; 7:397–399. [PubMed: 18024780]
11. Voon V. Repetition, repetition, and repetition: compulsive and punding behaviors in Parkinson's disease. *Mov Disord*. 2004; 19:367–370. [PubMed: 15077233]

12. Voon V, Fox S. Medication-related impulse control and repetitive behaviors in Parkinson disease. *Arch Neurol*. 2007; 64:1089–1096. [PubMed: 17698698]
13. Bostwick JM, Bucci JA. Internet sex addiction treated with naltrexone. *Mayo Clin Proc*. 2008; 83:226–230. [PubMed: 18241634]
14. Falhammar H, Yarker JY. Pathological gambling and hypersexuality in cabergoline-treated prolactinoma. *Med J Aust*. 2009; 190:97. [PubMed: 19236300]
15. Davie M. Pathological gambling associated with cabergoline therapy in a patient with a pituitary prolactinoma. *J Neuropsychiatry Clin Neurosci*. 2007; 19:473–474. [PubMed: 18070857]
16. Almanzar S, Zapata-Vega MI, Raya JA. Dopamine agonist-induced impulse control disorders in a patient with prolactinoma. *Psychosomatics*. 2012 in press.
17. Martinkova J, Trejbalova L, Sasikova M, et al. Impulse control disorders associated with dopaminergic medication in patients with pituitary adenomas. *Clin Neuropharmacol*. 2011; 34:179–181.
18. Lesieur HR, Blume SB. The South Oaks Gambling Screen (SOGS): a new instrument for the identification of pathological gamblers. *Am J Psychiatry*. 1987; 144:1184–1188. [PubMed: 3631315]
19. Cornelius JR, Tippmann-Peikert M, Slocumb NL, et al. Impulse control disorders with the use of dopaminergic agents in restless legs syndrome: a case-control study. *Sleep*. 2010; 33:81–87. [PubMed: 20120624]
20. Viana MC, Andrade LH. Lifetime prevalence, age and gender distribution and age-of-onset of psychiatric disorders in the Sao Paulo metropolitan area, Brazil: results from Sao Paulo Megacity Mental Health Survey. *Revista Brasileira De Psiquiatria*. 2012; 34:249–260. [PubMed: 23429770]
21. Athanasoulia AP, Ising M, Pfister H, et al. Distinct dopaminergic personality patterns in patients with prolactinomas: a comparison with nonfunctioning pituitary adenoma patients and age- and gender-matched controls. *Neuroendocrinology*. 2012; 96:204–211. [PubMed: 22343218]
22. Dang D, Cunningham D, Swieca J. The emergence of devastating impulse control disorders during dopamine agonist therapy of the restless legs syndrome. *Clin Neuropharmacol*. 2011; 34:66–70. [PubMed: 21412200]
23. Beebe TJ, Jenkins SM, Anderson KJ, et al. Survey-related experiential and attitudinal correlates of future health survey participation: results of a statewide survey. *Mayo Clin Proc*. 2008; 83:1358–1363. [PubMed: 19046555]
24. Voon V, Schoerling A, Wenzel S, et al. Frequency of impulse control behaviours associated with dopaminergic therapy in restless legs syndrome. *BMC Neurology*. 2011; 11:117. [PubMed: 21955669]

TABLE 1

Demographics and response rated for all survey recipients:

Variable	Group A Prolactinoma group	Group B Non-functioning pituitary adenoma group	P value
Age, years (SD)	50.9 (15.2)	53.7(16.2)	0.07
Sex, % Women	55%	64%	0.0004
Responders (%)	39.5%	38%	0.6

TABLE 2

Demographics of all survey recipients by responder status:

Variable	Group A Prolactinoma group		Group B Non-functioning pituitary adenoma group	
	Responders	Non-responders	Responders	Non-responders
Age, years (SD)	54.58 (14.6)	48.5 (15.2)	56.94(14.1)	51.88(17.1)
Sex (F/M), %F	30/47, 40%	61/60, 50%	44/26, 63%	80/44, 65%
				P value
				0.04
				0.98

TABLE 3

Clinical characteristics in responders

Variable	Group A Prolactinoma group n = 77	Group B Non-functioning pituitary adenoma group n = 70	P value
Age, in years Mean (SD)	54.6 (14.4)	56.9 (14.2)	0.33
Sex, n, males/females (n%, males/females)	47/30 (61%/39%)	27/43 (39%/61%)	0.008
Size tumour, in mm Mean (SD)	10.59 (9.59)	10.03 (8.17)	0.71
Hypogonadism n (%)	25 (32.47%)	10 (14.29%)	0.01
Other pituitary deficiency n (%)	17 (22.08%)	8 (11.43%)	0.12
Psychiatric disorders n (%)	22 (28.57%)	24 (34.29%)	0.48
Pituitary surgery n (%)	21 (27.21%)	19 (27.14%)	1

TABLE 4

ICDs in patients with prolactinomas and patients with non-functioning pituitary adenomas

Variable	Group A Prolactinoma group n = 77	Group B Non-functioning pituitary adenoma group n = 70	OR	P value
Excessive gambling n (%)	5 (6.49%)	4 (5.71%)	1.15	1
Excessive shopping n (%)	4 (5.19%)	9 (12.86%)	0.37	0.14
Hypersexuality n (%)	10 (12.99%)	2 (2.86%)	5.07	0.03
Punding n (%)	7 (9.09%)	5 (7.14%)	1.3	0.77
Any ICD, n (%)				
Men & Women	19 (24.68%)	12 (17.14%)	1.58	0.31
Men	13/47(27.7%)	1/27(3.7%)	9.94	0.005
Women	6/30(20%)	11/47(25.6%)	0.7	0.58

Table 5
Prolactinoma patients who developed Hypersexuality while on Dopamine Agonist therapy

N	Age, years	Sex, M/F	Tumour size (last MRI), mm	DA, weekly dose in mg	Comment
1	66	M	12	Cabergoline, 1 mg	Extreme symptomatology, leading to loss of job, divorce, promiscuity.
2	33	M	8	Cabergoline, 0.5 mg	Could not be reached
3	43	F	5	Cabergoline, 0.5 mg	Symptoms resolved after cabergoline was stopped by endocrinologist
4	46	F	5	Cabergoline, 0.5 mg	Symptoms not interfering with life
5*	60	M	32	Cabergoline, 1 mg	Patient recalls that symptoms improved with lowering the cabergoline dose.
6	38	M	21	Bromocriptine, 52.5mg	Symptoms improved with dose reduction to 35 mg weekly. Dose further decreased during follow up visit to 17.5 mg weekly
7	39	M	0	Cabergoline, does not recall the dose	Symptoms resolved after cabergoline was stopped due to curative pituitary surgery
8	47	M	3	Cabergoline, 0.5mg	Symptoms not interfering with life
9	66	M	3	Cabergoline, 2 mg	Symptoms not interfering with life, dose decreased by provider
10	53	F	2	Bromocriptine, 35 mg	Symptoms resolved after bromocriptine was stopped by endocrinologist

* patient with panhypopituitarism