

CLINICAL STUDY

Quality of life is impaired in association with the need for prolonged postoperative therapy by somatostatin analogs in patients with acromegaly

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Abstract

Objective: To assess the influence of long-acting somatostatin analogs (SSTA) after initial pituitary surgery on long-term health-related quality of life (HR-QoL) in relation to disease control in patients with acromegaly.

Design: This is a cross-sectional study in two tertiary referral centers in The Netherlands.

Patients and methods: One hundred and eight patients with acromegaly, in whom transsphenoidal ($n=101$, 94%) or transcranial ($n=7$, 6%) surgery was performed. Subsequently, 46 (43%) received additional radiotherapy and 41 (38%) were on postoperative treatment with SSTA because of persistent or recurrent disease at the time of study. All subjects filled in standardized questionnaires measuring HR-QoL. Disease control at the time of study was assessed by local IGF1 SDS.

Results: IGF1 SDS were slightly higher in patients treated with SSTA in comparison with patients without use of SSTA (0.85 ± 1.52 vs 0.25 ± 1.21 , $P=0.026$), but the percentage of patients with insufficient control (IGF1 SDS >2) was not different (17 vs 9%, $P=0.208$). Patients using SSTA reported poorer scores on most subscales of the RAND-36 and the acromegaly QoL and on all subscales of the multidimensional fatigue inventory-20. A subgroup analysis in patients with similar IGF1 levels (SSTA+, $n=26$, IGF1 SDS 0.44 ± 0.72 vs SSTA-, $n=44$, IGF1 SDS 0.41 ± 0.65) revealed worse scores on physical functioning, physical fatigue, reduced activity, vitality, and general health perception across all HR-QoL questionnaires in patients treated with SSTA.

Conclusion: QoL is impaired in association with the need for prolonged postoperative therapy by SSTA in patients with acromegaly despite similar IGF1 levels.

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Introduction

Treatment options for patients with acromegaly have greatly evolved during the past decades. Transsphenoidal surgery (TSS) is currently the treatment of choice for most GH-producing pituitary adenomas. However, cure is not achieved in 5–25% of microadenomas and 32–60% of macroadenomas (1, 2), necessitating other treatment modalities for disease control such as radiotherapy (RT) and medical treatment.

RT is effective in lowering serum GH and IGF1 concentrations in patients with acromegaly, with biochemical control of the disease being achieved in 60% of patients within 10 years after irradiation (3).

In addition, receptor targets for medical therapy have emerged. The most widely used group of medication is somatostatin analogs (SSTA), which were introduced in

the 1980s. They bind to somatostatin receptors, thereby suppressing the secretion of GH and reducing somatotroph cell mass. They also act on the liver to block the synthesis of IGF1 (4). In about 60% of patients treated with SSTA, biochemical control can be achieved (5, 6). Other medical treatment options include GH receptor antagonists and dopamine agonists. Combinations of medical therapies are increasingly applied (7).

Quality of life (QoL) is reported to be severely impaired in patients with acromegaly, measured both by general health-related and by disease-specific questionnaires (8, 9). Patients with biochemically controlled acromegaly have significantly better QoL than patients with persistent disease (10, 11, 12, 13). Other factors associated with reduced QoL in patients with acromegaly are prior RT, presence of clinical osteoarthritis, and GH deficiency (14, 15, 16).

Less is known about QoL in patients treated with SSTA, despite the fact that a substantial portion of patients with acromegaly use this medication for biochemical control of their disease (17). Only two studies investigated the effects of SSTA on QoL and concluded that improvement of symptoms relating to psychological distress, well-being, social fears, and QoL occurs after treatment with Lanreotide (18, 19). However, these studies did not compare the effects on QoL with other treatment modalities. In fact, Hua *et al.* (20) are the only ones reporting effects of treatment with or without SSTA on QoL related to remission status in acromegaly. In their small study, use of SSTA was associated with worse acromegaly QoL (AcroQoL) scores in patients with disease control. Although patients with SSTA had higher IGF1 concentrations than patients without SSTA, this did not reach significance. Furthermore, they found no effect of remission status on QoL. Thus, controversy exists because these findings are in contrast to previous studies showing that both controlled disease and IGF1 are associated with improved QoL (10, 11, 12).

Therefore, we investigated the influence of post-operative use of long-acting SSTA on long-term health-related QoL (HR-QoL) in relation to disease control in patients surgically treated for acromegaly in a large cross-sectional study in two tertiary referral centers.

Patients and methods

Study population

Patients with acromegaly were recruited for participation at the endocrine outpatient clinics of the University Medical Center Groningen (UMCG) and the Radboud University Nijmegen Medical Center, which are both large tertiary referral centers for pituitary surgery. All patients were between 20 and 75 years old. These age criteria were chosen because appropriate local reference data with regard to QoL are available. The initial diagnosis of acromegaly was based on the characteristic clinical signs and symptoms and confirmed by insufficient suppression of GH during an oral glucose tolerance test (oGTT), elevated age-adjusted IGF1 concentrations, and the presence of a pituitary adenoma on radiologic imaging. Patients were only recruited for participation if they were still actively followed at our endocrine outpatient clinics to ensure accuracy and completeness of data collection. All patients included in this study underwent surgery as primary treatment, in some cases followed by a second surgical procedure. Surgery was performed in both centers by specialized pituitary neurosurgeons between 1975 and 2008. RT was given postoperatively as previously described (21). SSTA were prescribed postoperatively in case of persistent or recurrent disease in

accordance with the standard of care at the time of treatment (1). In The Netherlands, short-acting SSTA have been available from 1985 and long-acting SSTA from 1989.

Questionnaires on QoL, use of medication, presence of comorbidity, and social status were sent to all patients by mail. Questionnaires were returned by mail.

Use of medication and presence of comorbidity were also confirmed by investigation of the medical charts. The interval between last treatment (surgery, RT, or initiation of SSTA) and QoL assessment was at least 12 months.

Baseline demographic characteristics (age, gender, and life expectancy), tumor size, type and outcome of treatment (recurrent or persistent disease, hormonal substitution therapy), and biochemical control of acromegaly at the time of the study were collected. In addition, data with regard to the use of SSTA, GH receptor antagonists, and dopamine agonists at last visit were recorded.

Disease activity was assessed by regular oGTT (except in patients treated with SSTA or Pegvisomant) and measurement of serum GH and IGF1 concentrations. For the present analysis, disease control at the time of study was assessed by IGF1. Pituitary insufficiency was treated with L-T₄, glucocorticoid supplementation, testosterone, or estrogens (in premenopausal women) when deficiencies were documented using appropriate basal hormone and dynamic tests (22).

Patients of the UMCG participated in 2005 and patients of Radboud University Nijmegen Medical Center in 2008 and 2009.

Approval was given by the medical ethics review committee of both centers.

Definitions

Criteria for remission and relapse Remission was defined as the disappearance of clinical signs of active GH hypersecretion in addition to normal IGF1 concentrations (\leq mean + 2 s.d.s for age) and suppression of serum GH levels during oGTT < 1.0 $\mu\text{g/l}$ within the first 3 months after surgery.

Relapse was defined as the development of clinical signs of active GH hypersecretion after initial remission with elevated IGF1 concentrations ($>$ mean + 2 s.d.s for age) and serum GH levels ≥ 1.0 $\mu\text{g/l}$ during oGTT.

Biochemical disease control was defined as normal IGF1 concentrations (\leq mean + 2 s.d.s for age).

Laboratory assays

In Groningen, plasma IGF1 was measured by RIA after acid-ethanol extraction (Nichols Institute of Diagnostics, San-Juan Capistrano, CA, USA) (21). In Nijmegen, serum IGF1 was measured by an in-house RIA (23).

For each IGF1 assay reference values were derived from healthy subjects. For the purpose of uniform reporting, IGF1 results are primarily expressed as age-corrected SDS, allowing direct comparison between both centers.

For the analysis of IGF1 SDS, only those scores were analyzed that were measured within the last year of follow-up and at least 3 months after surgery, after initiation or withdrawal of SSTA, to properly reflect disease activity after a change in therapy. This is consistent with clinical guidelines regarding reliability of IGF1 measurements (24).

QoL questionnaires

RAND-36 HR-QoL was measured with the RAND-36, which is identical to the 36-item short-form health survey (SF-36). Both versions are nowadays available in the public domain. The SF-36 and RAND-36 include the same set of items. Only scoring of the general health and pain subscales is different, but the differences are very small between both scoring systems. The questionnaire contains 36 questions recording various dimensions of general well-being over the previous 4 weeks. The items are formulated as statements or questions with Likert scale response options. The 36 questions are organized into nine scales (physical functioning, physical problems, bodily pain, general health, vitality, social functioning, emotional problems, and mental health) that are linearly converted to a scale of 0–100. The first three parameters measure physical health, the last three parameters measure mental health and the general health and vitality scales are sensitive to both physical and mental health outcomes. Higher scores represent better QoL (25). Normative data by age are available for the Dutch population (26).

Multidimensional fatigue inventory-20 The multidimensional fatigue inventory-20 (MFI-20) records fatigue and contains 20 statements, organized into five scales (general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue), with a maximum score of 20 on each subscale (27). Higher scores indicate a higher level of fatigue or impairment. Dutch normative data were derived from Smets *et al.* (28).

Hospital Anxiety and Depression Scale The Hospital Anxiety and Depression Scale (HADS) consists of 14 items related to anxiety and depression (29). Each item is scored as a number, with a maximal score for each subscale (anxiety or depression) of 21, higher scores indicating more severe anxiety or depression. Clinical depression or anxiety is indicated by a score of 6 or higher on the depression scale or 7 or higher on the anxiety scale. Dutch normative data were derived from Spinhoven *et al.* (30).

Acromegaly QoL The AcroQoL Questionnaire is a disease-specific questionnaire, which is suitable for measuring HR-QoL. It comprises 22 questions. Each question has five possible answers scored from 1 to 5, with a total maximum score of 110, which is quoted as a percentage. A score of 110 reflects the best possible QoL. The 22 questions are divided into the two main categories of physical and psychological function. The psychological dimension is subdivided into the subdimensions of appearance and personal relationships (31, 32).

Statistical analysis

Differences were assessed with *t*-tests (for continuous variables) or χ^2 tests (for categorical variables). An alpha level of 0.05 was used for determining the statistical significance. For graphical representation, study population mean SDS with 95% confidence intervals are shown. SPSS 18.0.3 (SPSS, Inc., Armonk, NY, USA) was used for data analysis.

Results

Study population

One hundred and sixty-four patients were eligible for the present study and were sent questionnaires on HR and acromegaly-specific QoL, mood, and fatigue by mail. One hundred and eight patients (of which 47 men and 61 women, age 44 ± 12 years) returned all questionnaires (response rate of 66%). TSS was performed in 101 (94%), and a transcranial approach was used in seven

Table 1 Demographic characteristics and outcome of treatment data of patients with or without use of SSTA. Data are given as absolute number (%) or as mean \pm s.d.

	SSTA+	SSTA–	P value
Number	41	67	
Age at diagnosis (years)	40.6 \pm 11.3	42.2 \pm 10.6	NS
Gender (male/female)	24/17	23/44	0.014
Age at study	54.8 \pm 11.6	53.6 \pm 11.2	NS
Macroadenoma	30 (73)	52 (78)	NS
TSS/craniotomy	38/3	63/4	NS
Second surgical procedure	8 (20)	5 (7)	NS
Cured after surgery	0 (0)	38 (57)	
Radiotherapy	17 (41)	29 (43)	NS
Medication at last visit			
Somatostatin analog	41 (100)	0 (0)	
Pegvisomant	4 (10)	4 (6)	NS
Dopamine agonist	7 (17)	2 (3)	0.010
Substitution of pituitary axis			
Thyroid hormone	20 (49)	22 (33)	NS
Glucocorticoids	17 (41)	21 (31)	NS
Sex hormones			
Men	14 (58)	8 (35)	NS
Women	2 (12)	4 (9)	NS
GH	0 (0)	3 (4)	NS
Antidiuretic hormone	3 (7)	3 (4)	NS

TSS, transsphenoidal surgery; NS, not significant.

Table 2 Daily activities, comorbidity, and mood in patients with or without use of SSTA. Data are given as absolute number (%) or as mean \pm s.d.

	SSTA +	SSTA -	P value
Number	41	67	
HADS			
Anxiety	5.1 \pm 3.6	4.9 \pm 4.1	NS
Depression	5.1 \pm 3.7	4.3 \pm 4.1	NS
Daily activities			
Paid work	20 (49)	31 (46)	NS
Full-time employment	16 (39)	28 (42)	NS
Working hours/week	34 \pm 11	30 \pm 12	NS
Comorbidity			
Heart disease	5 (12)	2 (3)	NS
Hypertension	15 (37)	23 (34)	NS
Cerebrovascular disease	0 (0)	1 (1)	NS
Type 2 diabetes	6 (15)	4 (6)	NS
Malignancy	2 (5)	1 (1)	NS
Psychological problems	3 (7)	11 (16)	NS
Arthritis/arthrosis	10 (24)	22 (33)	NS

NS, not significant.

(6%) patients. A second surgical procedure was performed in 13 (12%) of patients because of persistent or recurrent disease. Forty-six patients (43%) received postoperative RT. Treatment with SSTA was used by 41 patients (38%) at the time of study. The baseline characteristics including IGF1 SDS of the entire cohort of acromegalic patients who received primary surgical treatment in our centers did not differ from the present study population.

Patient groups

The characteristics of patients who were using SSTA at the last visit (SSTA+) compared to those who were not (SSTA-) are shown in Table 1. The patients in the SSTA+ group had a macroadenoma, a craniotomy, a second surgical procedure, and postoperative RT as often as patients in the SSTA- group. There was a trend toward more thyroid hormone substitution in the SSTA+ group, but there were no differences in frequency of substitution of other pituitary insufficiencies. Feelings of anxiety and depression (HADS) were comparable between groups and not indicative of a state of clinical anxiety or depression (Table 2). Social status, full-time/part-time employment, social security benefit, and comorbidities were all similar between groups at the time of assessment (Table 2).

IGF1 SDS and HR-QoL

IGF1 SDS were higher in the patients treated with SSTA compared with the patients without use of SSTA (0.85 ± 1.52 vs 0.25 ± 1.21 , $P=0.026$), but the percentage of patients with insufficient (biochemical) control (IGF1 SDS > 2) was not different between the

two groups (17 vs 9%, $P=0.208$). Patients using SSTA reported poorer scores on five of the eight subscales of the RAND-36 and on all subscales of the MFI-20 (Table 3). In addition, scores on the AcroQoL were worse in patients treated with SSTA. Figure 1 shows the differences in SDS between the two groups with respect to the IGF1, HADS, RAND-36, and MFI-20.

HR-QoL, subgroup analysis corrected for IGF1 SDS

For a subgroup analysis all patients with an IGF1 SDS between +1.5 and -1 were selected. This resulted in a group of 26 patients using SSTA at the time of this study and 44 patients who were not treated with SSTA. Both groups had similar biochemical control as measured by IGF1 SDS (SSTA+ 0.44 ± 0.72 vs SSTA- 0.41 ± 0.65). Patients treated with SSTA reported significantly worse scores on physical functioning, physical fatigue, reduced activity, vitality, and general health perception across all HR-QoL questionnaires (Fig. 2).

In multivariate analysis, SSTA use and female gender were highly significantly associated with worse scores on the AcroQoL, but age, RT, and IGF1 SDS were not (Table 4).

Table 3 QoL in patients with or without use of SSTA.

	Mean \pm s.d.		P value*	Population reference
	SSTA +	SSTA -		
RAND-36				
Physical functioning	65 \pm 26	79 \pm 23	0.004	82 \pm 23
Social functioning	66 \pm 27	75 \pm 25	NS	87 \pm 21
Role limitations physical problems	46 \pm 40	65 \pm 44	0.024	79 \pm 36
Role limitations emotional problems	78 \pm 36	75 \pm 39	NS	84 \pm 32
Mental health	72 \pm 16	75 \pm 17	NS	77 \pm 18
Vitality	48 \pm 24	58 \pm 20	0.015	67 \pm 20
Pain	65 \pm 27	78 \pm 23	0.010	80 \pm 26
General health perception	49 \pm 22	63 \pm 23	0.003	73 \pm 23
MFI-20				
General fatigue	14.2 \pm 4.7	12.1 \pm 5.5	0.050	9.9 \pm 5.2
Physical fatigue	14.0 \pm 4.5	10.4 \pm 5.1	< 0.001	8.8 \pm 4.9
Mental fatigue	11.6 \pm 4.9	9.5 \pm 5.0	0.042	8.7 \pm 4.6
Reduced activity	12.0 \pm 5.2	9.5 \pm 4.1	0.008	8.2 \pm 4.0
Reduced motivation	11.0 \pm 4.8	9.0 \pm 4.3	0.031	8.3 \pm 4.8
AcroQoL				
Physical	25.2 \pm 6.8	28.7 \pm 7.1	0.012	NA
Psychological	46.5 \pm 10.8	50.7 \pm 9.9	0.046	NA
Subscale appearance	21.1 \pm 6.1	23.8 \pm 5.5	0.019	NA
Subscale personal relations	25.7 \pm 5.3	26.9 \pm 5.4	NS	NA
Total score	71.7 \pm 16.8	79.2 \pm 15.5	0.022	NA

SSTA+, use of SSTA at the time of study; SSTA-, no use of SSTA at the time of study; NA, not applicable; NS, not significant. *P value SSTA+ vs SSTA-.

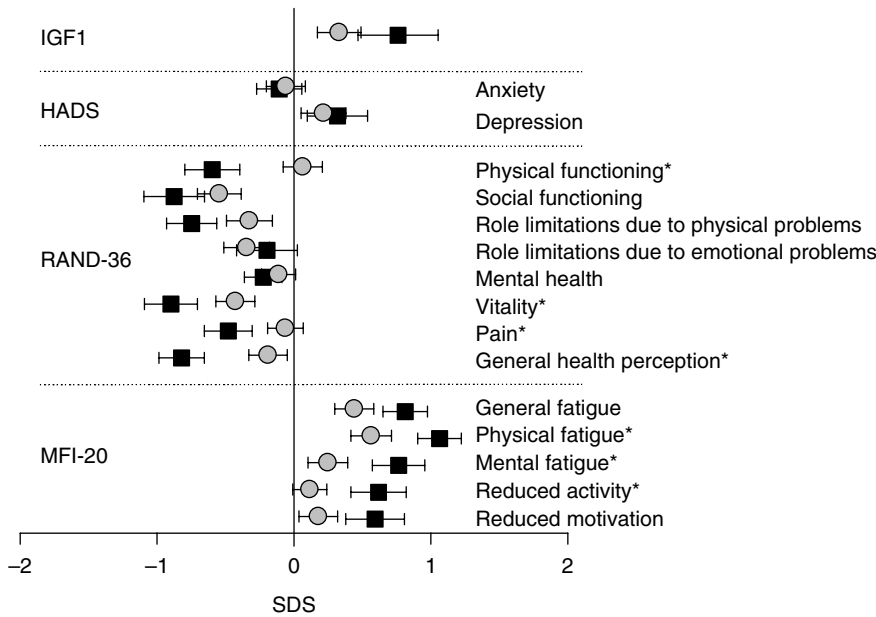


Figure 1 SDS for IGF1, HADS, RAND-36, and MFI-20 in patients treated with or without SSTA. Grey circles are patients without somatostatin analogs at time of the study. Black squares are patients with somatostatin analogs at time of the study. Data represent mean \pm 95% confidence interval of mean. * $P < 0.05$ for mean differences.

Discussion

In this study we observed that QoL was impaired in association with the need for prolonged postoperative therapy with SSTA in patients with acromegaly despite similar IGF1 levels. This association was found across all HR-QoL questionnaires. The differences that were found can be considered clinically relevant, since differences of more than ten points were found in the RAND-36 subscales (26). Subjects treated with SSTA had lower scores with regard to physical functioning, physical fatigue, reduced activity, vitality, and general health

perception. These differences could not be attributed to differences in mood, patient characteristics, or comorbidities.

This is the first QoL study that takes both biochemical control by IGF1 SDS and the use of SSTA into account. Both groups of patients, with or without SSTA, were highly similar with regard to age, hormonal substitution, and comorbidities. Further, our study did not rely only on the disease-specific AcroQoL but also on generic scales measuring HR-QoL and fatigue. A previous study by Hua *et al.* (20) showed that in the group of patients with disease control, treatment with

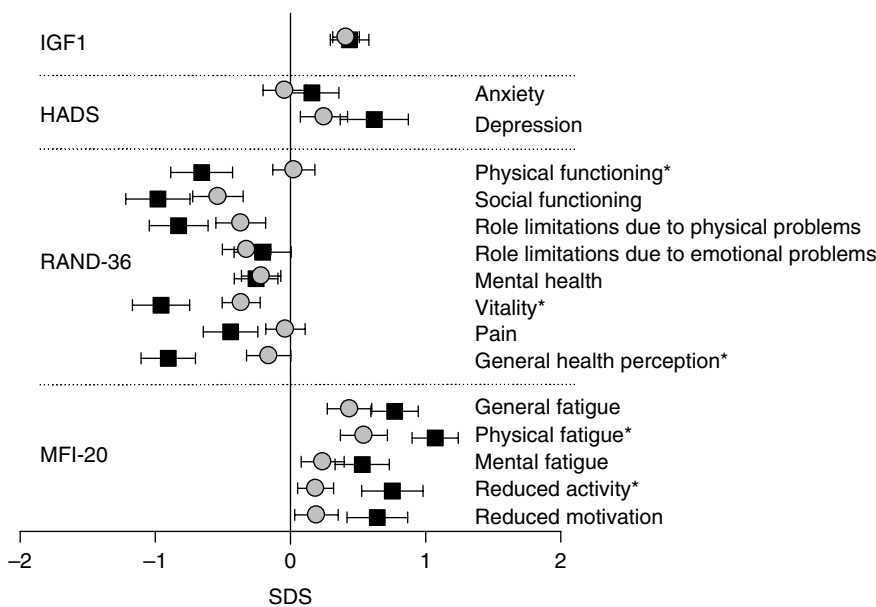


Figure 2 SDS for IGF1, HADS, RAND-36, and MFI-20 in patients treated with or without SSTA matched for IGF1 SDS. Grey circles are patients without somatostatin analogs at time of the study. Black squares are patients with somatostatin analogs at time of the study. Data represent mean \pm 95% confidence interval of mean. * $P < 0.05$ for mean differences.

Table 4 Multivariate analysis of age, gender, treatment (SSTA and radiotherapy) and IGF1 SDS on AcroQoL subscales and total score.

Variable	AcroQoL subscale									
	Physical		Psychological		Appearance		Relations		Total score	
	β	P value	β	P value	β	P value	β	P value	β	P value
Age (years)	-0.159	0.097	-0.132	0.175	-0.147	0.122	-0.101	0.312	-0.160	0.097
Gender (male vs female)	-0.177	0.071	-0.271	0.008	-0.275	0.005	-0.193	0.063	-0.259	0.010
SSTA (- vs +)	-0.274	0.005	-0.265	0.008	-0.289	0.003	-0.167	0.102	-0.286	0.004
Radiotherapy (- vs +)	-0.178	0.064	-0.095	0.331	-0.059	0.538	-0.114	0.259	-0.144	0.135
IGF1 SDS	-0.018	0.860	0.027	0.790	0.019	0.846	0.045	0.669	0.013	0.894

SSTA, use of somatostatin analogs at the time of study; β , standardized regression coefficient.

Lanreotide was associated with worse AcroQoL scores. This study was small, comparing 13 patients on Lanreotide treatment with 17 patients with cure of disease. Our much larger study in two tertiary referral centers confirms and extends this finding by showing an association of poorer QoL and use of SSTA independent of IGF1 SDS.

For the subgroup analysis of patients with a similar IGF1 SDS, all patients with an IGF1 SDS < -1 and $> +1.5$ were excluded. These cutoff scores were chosen to maintain a sufficiently large group size and to exclude patients with subtle GH deficiency or excess. Previously, Kauppinen-Makelin *et al.* (11) described a U-shaped relationship of nadir GH levels in an oGTT with QoL. And GH deficiency is reported to be associated with decreased QoL in patients with prior acromegaly (16). As illustrated in Fig. 2, even in patients with identical IGF1 SDS the association of use of SSTA with poorer QoL persisted. In agreement, multivariate analysis explicitly performed to detect the influence of IGF1 SDS on the AcroQoL revealed similar results (Table 4).

In contrast to some studies we did not find an effect of IGF1 SDS or disease control on QoL (10, 11, 12, 13). One possibility is that only 13 of our total cohort of 108 patients were not biochemically controlled resulting in a group that is too small to detect differences. However, our findings are in agreement with other large studies that also failed to find a (long-term) effect of IGF1 on QoL (11, 33), suggesting perhaps that factors other than serum IGF1 participate in the well-being of acromegalic patients. It can be speculated that this may be glycemic control. However, the presence of type 2 DM was not found to be a significant contributor to the AcroQoL scores (data not shown).

Our study is limited by its cross-sectional design to infer causality between the use of SSTA and QoL. It suggests by association that different treatment modalities in acromegaly result in different disease-related outcomes. Another potential limitation is the use of IGF1 as a single measure of biochemical control. Although we agree that including GH concentrations in the present analysis would potentially be informative, it must be noted that use of medication to control GH concentrations interferes with GH secretory patterns (34) resulting in unreliable group comparisons with regard

to random GH concentrations. In addition, clinical guidelines advocate not assessing disease activity by an oGTT while receiving medical treatment (1).

Previous studies have shown that levels of GH and IGF1 may be discordant in several circumstances (35, 36). This potentially suggests that impaired QoL may be a result of different GH concentrations and secretory profiles in spite of normalized IGF1 SDS. Indeed, Biermasz *et al.* (34) demonstrated that octreotide represses secretory-burst mass and nonpulsatile secretion but does not lead to restoration of event frequency or orderly GH secretion in acromegaly. In addition, a new concept of extrahepatic acromegaly induced by SSTA has been introduced. It is postulated by Neggars *et al.* (37) that long-acting SSTA normalize serum IGF1 levels in certain patients in the presence of elevated GH actions in extrahepatic tissues. Also, Rubeck *et al.* (38) compared traditional and novel biomarkers and health status in patients with acromegaly treated with either surgery alone or SSTA. These authors concluded that despite similar and normalized IGF1 levels, SSTA treatment compared with surgery alone was associated with less suppressed GH levels and less symptom relief. These discordant findings were speculated to be attributed to the specific suppression of hepatic IGF1 production by SSTA. It led to their recommendation that biochemical assessment during SSTA treatment should include both GH and IGF1. All these studies point to biological effects of subtle abnormalities in GH secretion in patients treated with SSTA. A practical consequence of this may be that relying solely on normalization of IGF1 SDS may be falsely reassuring.

Besides the possibility of differences in GH concentrations in controlled and cured patients, the alternative of a direct negative influence of SSTA on QoL by a GH-independent mechanism must be considered. SSTA is a nonspecific inhibitor of various hormone systems and has also been associated with persistent diastolic dysfunction (39), increased sleep latency (40), and fat-soluble vitamin deficiency (41).

Patients without use of SSTA were more often women. This may have underestimated differences, since it is well known that women report a lower QoL than men (26). In addition, differences in hormone

substitution may be of relevance. However, we have previously shown that this was not an important confounder in patients with nonfunctioning pituitary macroadenomas (21). Multivariate analysis (data not shown) also did not point in this direction. Other treatment modalities like RT have been reported to negatively influence QoL in acromegaly (11, 14). In our study, both univariate and multivariate analyses did not show a significant effect of RT on many subscales of QoL. It must be noted that patients who underwent pituitary RT had better biochemical control than those who did not receive RT (IGF1 SDS 0.12 ± 0.17 vs 0.75 ± 0.18 , $P < 0.001$). However, a trend toward worse QoL in one (physical) subscale of the AcroQoL was seen in patients who underwent RT.

Our study points out that achievement of all treatment goals is not obvious for every therapeutic modality. Different treatment options may result in similar biochemical control, but their efficacy on several other treatment goals, such as QoL, may vary. Differences may be explained by subtle but persistent underlying disease activity or an intrinsic negative effect of treatment.

In conclusion, patients treated with SSTA for acromegaly report a substantially poorer QoL. These findings were independent of IGF1 SDS.

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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