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ADRENAL INCIDENTALOMAS: EFFECT OF SIZE ON CORTISOL SECRETION AND CLINICAL FEATURES

Abstract: **Purpose**: The aim of this study was to assess the relationship between adrenal incidentaloma size, cortisol secretion suppressibility by dexamethasone and relevant clinical and laboratory parameters. **Methods**: This retrospective study included all patients diagnosed with adrenal incidentaloma and admitted to the single department of the Clinic of Endocrinology, Diabetes and Diseases of Metabolism during the period from 2012 till the end of 2019. The inclusion criterion was the presence of an asymptomatic adrenal mass on imaging not performed for suspected adrenal disease. The study group included 197 subjects. Adrenal masses were detected using CT or NMR scan. We analysed the correlation between tumour size and relevant hormonal and clinical parameters. **Results**: We found a significant positive correlation between incidentaloma size and morning cortisol, cortisol after overnight dexamethasone, and a significant negative correlation between incidentaloma size and morning ACTH, and hip T score. Also, there was a weak but statistically significant correlation between incidentaloma size and systolic blood pressure. **Conclusions**: Our study shows that the prevalence of adrenal autonomous cortisol secretion increases with incidentaloma size, and that prevalence of hypertension and osteoporosis also increases with an increase of incidentaloma size

Keywords: Adrenal incidentaloma, Adrenal Gland Neoplasms, Pituitary-Adrenal System, Adrenal Imaging, Cushing Syndrome, Hypertension, Osteoporosis

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Introduction

An adrenal incidentaloma is an adrenal mass detected on imaging not performed for suspected adrenal disease or the symptoms related to adrenal hormone excess [1]. Using high-resolution CT overall prevalence of adrenal lesions was 4.4% [2]. Prevalence increases with age, reaching 10% in the elderly [3]. Bilateral incidentalomas are found in about 10% of the cases [4]. Subclinical Cushing's syndrome is diagnosed in 20% of the adrenal incidentaloma patients [5]. Patients with subclinical Cushing's syndrome have increased all-cause mortality and cardiovascular-specific mortality, and a higher prevalence of type 2 diabetes, osteoporosis, fractures and infection [6]. It was also found, that size of adrenal incidentaloma correlates with insulin sensitivity [7].

The aim of this study was to assess the relationship between adrenal incidentaloma size, cortisol secretion suppressibility by dexamethasone and relevant clinical and laboratory parameters.

Materials and methods

This retrospective study included all patients diagnosed with adrenal incidentaloma and admitted to the single department of the Clinic of Endocrinology, Diabetes and Diseases of Metabolism during the period from 2012 till the end of 2019. The inclusion criterion was the presence of an asymptomatic adrenal mass on imaging not performed for suspected adrenal disease [1]. Patients with adrenal masses detected during staging for malignant conditions were excluded. The study group included 215 subjects, but 18 subjects were excluded due to missing data, leaving 197 subjects in the study. Relevant subject data are presented in Table 1.

Table1. Patient, hormonal and clinical data

	SMALL	LARGE	TOTAL	P VALUE
Sex				0.104
Male	35 (31.0%)	17 (20.2%)	52 (26.4%)	
female	78 (69.0%)	67 (79.8%)	145 (73.6%)	
Age				0.623
N	113	84	197	
Mean (95% CI)	60.1 (58.1, 62.1)	59.3 (56.5, 62.1)	59.8 (58.1, 61.4)	
BMI ($kg*m^{-2}$)				0.224
N	96	69	165	
Mean (95% CI)	29.9 (28.7, 31.0)	28.8 (27.4, 30.1)	29.4 (28.6, 30.3)	
Size (mm)				< 0.001
N	113	84	197	
Mean (95% CI)	20.4 (19.4, 21.5)	40.9 (38.2, 43.5)	29.2 (27.3, 31.0)	
Adrenalectomy				< 0.001
No	107 (94.7%)	63 (75.0%)	170 (86.3%)	
Yes	6 (5.3%)	21 (25.0%)	27 (13.7%)	
Bilateral				0.463
Bilateral	19 (16.8%)	18 (21.4%)	37 (18.8%)	
Unilateral	94 (83.2%)	66 (78.6%)	160 (81.2%)	

	SMALL	LARGE	TOTAL	P VALUE
Hypertension				0.624
Yes	82 (72.6%)	64 (76.2%)	146 (74.1%)	
No	31 (27.4%)	20 (23.8%)	51 (25.9%)	
Systolic Blood Pressure (mmHg)				0.078
N	103	79	182	
Mean (95% CI)	137.8 (133.5, 142.0)	143.9 (138.3, 149.5)	140.4 (137.0, 143.9)	
Diastolic Blood Pressure (mmHg)				0.099
N	103	79	182	
Mean (95% CI)	83.4 (81.1, 85.7)	86.4 (83.6, 89.1)	84.7 (82.9, 86.4)	
Diabetes mellitus				0.885
Yes	47 (41.6%)	34 (40.5%)	81 (41.1%)	
No	66 (58.4%)	50 (59.5%)	116 (58.9%)	
Blood glucose (mmol/l)				0.266
N	96	75	171	
Mean (95% CI)	6.3 (5.8, 6.8)	5.9 (5.6, 6.3)	6.1 (5.8, 6.5)	
HbA1C (%)				0.551
N	57	49	106	
Mean (95% CI)	6.4 (6.0, 6.7)	6.2 (5.9, 6.5)	6.3 (6.0, 6.5)	
Spine T score				0.322
N	25	17	42	
Mean (95% CI)	-1.7 (-2.0, -1.4)	-2.1 (-2.9, -1.2)	-1.8 (-2.2, -1.5)	
Hip T score				0.151
N	25	17	42	
Mean (95% CI)	-1.2 (-1.4, -0.9)	-1.6 (-2.2, -1.0)	-1.3 (-1.6, -1.0)	
Morning cortisol (nmol/l)				0.005
N	97	75	172	
Mean (95% CI)	397.9 (368.0, 427.8)	475.0 (427.1, 522.8)	431.5 (404.3, 458.6)	
Morning ACTH (pmol/l)				0.068
N	85	66	151	
Mean (95% CI)	4.0 (3.4, 4.6)	3.2 (2.6, 3.8)	3.7 (3.2, 4.1)	
Cortisol after dexametasone (nmol/l)				< 0.001
N	113	84	197	
Mean (95% CI)	53.0 (41.6, 64.3)	191.1 (128.7, 253.4)	111.9 (83.1, 140.6)	
Maximal cortisol after ACTH stimulation (nmol/l)				0.016
N	11	7	18	
Mean (95% CI)	619.7 (546.8, 692.6)	846.4 (616.5, 1076.4)	707.9 (606.4, 809.4)	
Adrenaline (nmol/24 h)				0.168
N	34	38	72	
Mean (95% CI)	16.2 (12.7, 19.6)	21.5 (14.8, 28.2)	19.0 (15.1, 22.8)	
Noradrenaline (nmol/24 h)				0.133
N	34	38	72	
Mean (95% CI)	194.1 (154.4, 233.7)	241.5 (193.4, 289.6)	219.1 (187.8, 250.4)	
Aldosterone (pmol/l)				0.26
N	12	18	30	
Mean (95% CI)	240.2 (114.9, 365.6)	163.4 (80.7, 246.1)	194.2 (126.9, 261.4)	

Adrenal masses were detected using CT or NMR scan. Imaging was done in different hospitals or imaging centres and interpreted by a different radiologist. In all subjects, at least one dimension was measured. In 172 (87%) subjects two dimensions were measured, and in 49 (25%) measurements of all three dimensions were reported. Because of the variety of image data reporting, we decided to use maximal reported diameter. Pearson correlation between the maximal reported diameter and the calculated surface was 0.91, while the correlation with calculated volume was 0.79.

In all subject overnight 1 mg dexamethasone test was done [1]. Hormonal and biochemical measurement are presented in Table 1. Bone mineral density was measured using dual-energy x-ray absorptiometry (Hologic Discovery W). ACTH test was performed in 18 subjects.

Post-dexamethasone cortisol concentrations were log 10 transformed because of the extreme right-skewed distribution.

To find optimal cut-off for the maximal reported diameter OptimalCutpoints R packages were used [8, 9].

Continuous data are presented as means and 95% confidence interval (95CI), and nominal data as count and percentages. Statistical analysis was done using Pearson correlation and linear regression, ANOVA and Fisher's exact test for nominal data.

Faculty of Medicine, University of Belgrade Ethics Committee (2650/XII-13) approved this study.

Results

Patient details are presented in Table 1. Almost three quarters (73.6%) of the patients were females. Patients were borderline obese (body mass index - BMI 29.4 kg/m^2), with an average of 59.8 years.

Bilateral incidentalomas were present in 37 subjects (18.8%). Subjects with bilateral incidentalomas had higher 24 h urinary adrenaline (bilateral: N=12, 28.5 95CI 13.7-43.3 nmol/24h, unilateral: N=60, 17.1 95CI 13.4-20.7 nmol/24h, p=0.027) and increased prevalence of diabetes ((59.5% vs.36.9% p=0.016). Data are presented in Supplemental Table 1.

Supplemental Table 1. Patient, hormonal and clinical data in bilateral and unilateral incidentalomas

VARIABLE	BILATERAL	UNILATERAL	TOTAL	P VALUE
Sex				0.305
m	7 (18.9%)	45 (28.1%)	52 (26.4%)	
z	30 (81.1%)	115 (71.9%)	145 (73.6%)	
Age				0.832
N	37	160	197	
Mean (95% CI)	59.4 (56.9, 62.0)	59.9 (57.9, 61.8)	59.8 (58.1, 61.4)	

VARIABLE	BILATERAL	UNILATERAL	TOTAL	P VALUE
BMI (kg*m^{-2})				0.263
N	32	133	165	
Mean (95% CI)	28.4 (26.4, 30.4)	29.7 (28.7, 30.6)	29.4 (28.6, 30.3)	
Size (mm)				0.091
N	37	160	197	
Mean (95% CI)	32.5 (27.6, 37.4)	28.4 (26.3, 30.4)	29.2 (27.3, 31.0)	
Groupl				0.463
Small	19 (51.4%)	94 (58.8%)	113 (57.4%)	
Large	18 (48.6%)	66 (41.2%)	84 (42.6%)	
Adrenalectomy				0.181
No	29 (78.4%)	141 (88.1%)	170 (86.3%)	
Yes	8 (21.6%)	19 (11.9%)	27 (13.7%)	
Hypertension				0.677
Yes	29 (78.4%)	117 (73.1%)	146 (74.1%)	
No	8 (21.6%)	43 (26.9%)	51 (25.9%)	
Systolic Blood Pressure (mmHg)				0.337
N	36	146	182	
Mean (95% CI)	137.1 (131.5, 142.7)	141.3 (137.2, 145.3)	140.4 (137.0, 143.9)	
Diastolic Blood Pressure (mmHg)				0.715
N	36	146	182	
Mean (95% CI)	84.0 (80.1, 87.9)	84.8 (82.9, 86.8)	84.7 (82.9, 86.4)	
Diabetes mellitus				0.016
Yes	22 (59.5%)	59 (36.9%)	81 (41.1%)	
No	15 (40.5%)	101 (63.1%)	116 (58.9%)	
Bloog glucose (mmol/l)				0.833
N	31	140	171	
Mean (95% CI)	6.2 (5.3, 7.1)	6.1 (5.8, 6.5)	6.1 (5.8, 6.5)	
HbA1C (%)				0.943
N	25	81	106	
Mean (95% CI)	6.3 (5.9, 6.7)	6.3 (6.0, 6.6)	6.3 (6.0, 6.5)	
Spine T score				0.925
N	8	34	42	
Mean (95% CI)	-1.9 (-3.4, -0.4)	-1.8 (-2.2, -1.5)	-1.8 (-2.2, -1.5)	
Hip T score				0.111
N	8	34	42	
Mean (95% CI)	-1.8 (-2.9, -0.7)	-1.2 (-1.5, -1.0)	-1.3 (-1.6, -1.0)	
Morning cortisol (nmol/l)				0.790
N	33	139	172	
Mean (95% CI)	423.9 (362.3, 485.6)	433.3 (402.7, 463.9)	431.5 (404.3, 458.6)	
Morning ACTH (pmol/l)				0.139
N	28	123	151	
Mean (95% CI)	3.0 (2.3, 3.7)	3.8 (3.3, 4.3)	3.7 (3.2, 4.1)	
Cortisol after dexametasone (nmol/l)				0.410
N	37	160	197	
Mean (95% CI)	136.9 (80.6, 193.2)	106.1 (73.0, 139.1)	111.9 (83.1, 140.6)	
Maximal cortisol after ACTH stimulation (nmol/l)				0.308
N	4	14	18	
Mean (95% CI)	802.4 (451.1, 1153.7)	680.9 (565.8, 795.9)	707.9 (606.4, 809.4)	
Adrenaline (nmol/24 h)				0.027
N	12	60	72	
Mean (95% CI)	28.5 (13.7, 43.3)	17.1 (13.4, 20.7)	19.0 (15.1, 22.8)	

VARIABLE	BILATERAL	UNILATERAL	TOTAL	P VALUE
Noradrenaline (nmol/24 h)				0.707
N	12	60	72	
Mean (95% CI)	232.4 (126.2, 338.6)	216.4 (183.7, 249.2)	219.1 (187.8, 250.4)	
Aldosterone (pmol/l)				0.997
N	10	20	30	
Mean (95% CI)	194.0 (71.8, 316.1)	194.2 (105.8, 282.7)	194.2 (126.9, 261.4)	

Twenty-seven patients were adrenalectomized. They had larger tumours (28.0 95CI 26.0-30.1 mm vs. 36.2 95CI 31.1-41.3 mm, p=0.003), and higher cortisol levels after dexamethasone (87.3 95CI 58.7- 115.8 nmol/l, vs. 266.8 95CI 174.1-359.4, p<0.001). Operated patients were dominantly females (92.6% vs. 70.6% p=0.017). Data are presented in Supplemental Table 2.

Supplemental Table 2. Patient, hormonal and clinical data in adrenalectomized and non-operated patients

VARIABLE	NON OPERATED	ADRENALECTOMY	TOTAL	P VALUE
Sex				0.017
m	50 (29.4%)	2 (7.4%)	52 (26.4%)	
z	120 (70.6%)	25 (92.6%)	145 (73.6%)	
Age				0.048
N	170	27	197	
Mean (95% CI)	60.4 (58.6, 62.2)	55.6 (51.9, 59.4)	59.8 (58.1, 61.4)	
BMI (kg*m^{-2})				0.002
N	143	22	165	
Mean (95% CI)	29.9 (29.0, 30.9)	26.0 (24.8, 27.2)	29.4 (28.6, 30.3)	
Size (mm)				0.003
N	170	27	197	
Mean (95% CI)	28.0 (26.0, 30.1)	36.2 (31.1, 41.3)	29.2 (27.3, 31.0)	
Group				< 0.001
Small	107 (62.9%)	6 (22.2%)	113 (57.4%)	
Large	63 (37.1%)	21 (77.8%)	84 (42.6%)	
Bilateral				0.181
Yes	29 (17.1%)	8 (29.6%)	37 (18.8%)	
No	141 (82.9%)	19 (70.4%)	160 (81.2%)	
Hypertension				0.479
Yes	124 (72.9%)	22 (81.5%)	146 (74.1%)	
No	46 (27.1%)	5 (18.5%)	51 (25.9%)	
Systolic Blood Pressure (mmHg)				0.06
N	155	27	182	
Mean (95% CI)	139.1 (135.4, 142.7)	148.2 (138.7, 157.7)	140.4 (137.0, 143.9)	
Diastolic Blood Pressure (mmHg)				0.094
N	155	27	182	
Mean (95% CI)	84.1 (82.2, 85.9)	88.3 (83.2, 93.3)	84.7 (82.9, 86.4)	
Diabetes mellitus				0.528
Yes	68 (40.0%)	13 (48.1%)	81 (41.1%)	
No	102 (60.0%)	14 (51.9%)	116 (58.9%)	
Bloog glucose (mmol/l)				0.708
N	147	24	171	

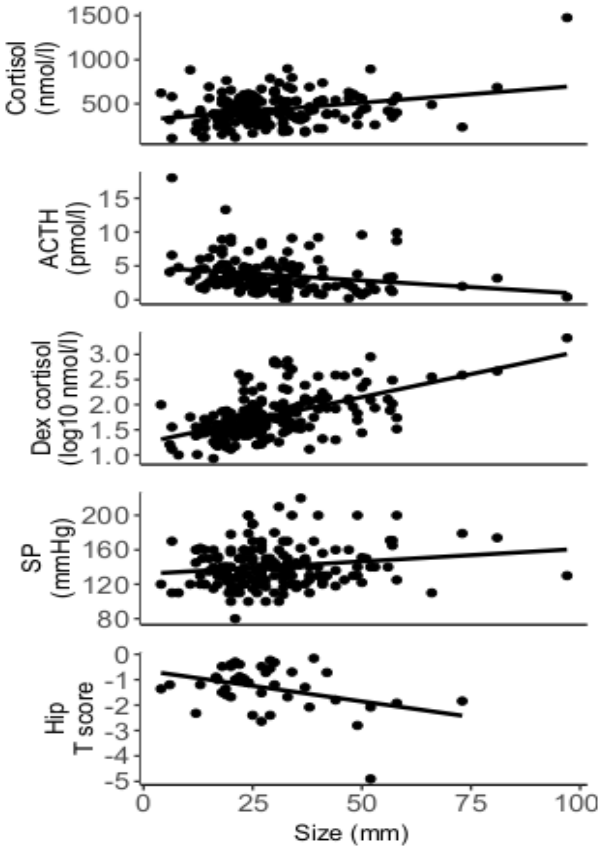
VARIABLE	NON OPERATED	ADRENALECTOMY	TOTAL	P VALUE
Mean (95% CI)	6.2 (5.8, 6.5)	6.0 (5.3, 6.7)	6.1 (5.8, 6.5)	
HbA1C (%)				0.525
N	89	17	106	
Mean (95% CI)	6.2 (6.0, 6.5)	6.5 (5.9, 7.0)	6.3 (6.0, 6.5)	
Spine T score				0.952
N	36	6	42	
Mean (95% CI)	-1.8 (-2.3, -1.4)	-1.8 (-2.6, -1.0)	-1.8 (-2.2, -1.5)	
Hip T score				0.645
N	36	6	42	
Mean (95% CI)	-1.3 (-1.6, -1.0)	-1.5 (-2.4, -0.6)	-1.3 (-1.6, -1.0)	
Morning cortisol (nmol/l)				0.015
N	148	24	172	
Mean (95% CI)	418.0 (389.0, 447.1)	514.4 (442.2, 586.7)	431.5 (404.3, 458.6)	
Morning ACTH (pmol/l)				0.103
N	129	22	151	
Mean (95% CI)	3.8 (3.4, 4.3)	2.8 (1.7, 3.9)	3.7 (3.2, 4.1)	
Cortisol after dexametasone (nmol/l)				< 0.001
N	170	27	197	
Mean (95% CI)	87.3 (58.7, 115.8)	266.8 (174.1, 359.4)	111.9 (83.1, 140.6)	
Maximal cortisol after ACTH stimulation (nmol/l)				0.005
N	15	3	18	
Mean (95% CI)	652.1 (564.4, 739.8)	986.8 (497.9, 1475.7)	707.9 (606.4, 809.4)	
Adrenaline (nmol/24 h)				0.354
N	58	14	72	
Mean (95% CI)	18.1 (13.9, 22.3)	22.7 (12.2, 33.1)	19.0 (15.1, 22.8)	
Noradrenaline (nmol/24 h)				0.004
N	58	14	72	
Mean (95% CI)	197.2 (169.2, 225.1)	309.8 (199.9, 419.8)	219.1 (187.8, 250.4)	
Aldosterone (pmol/l)				0.359
N	23	7	30	
Mean (95% CI)	211.1 (126.6, 295.5)	138.5 (36.0, 241.0)	194.2 (126.9, 261.4)	

We found a significant positive correlation between incidentaloma size and morning cortisol, and cortisol after overnight dexamethasone, and a significant negative correlation between incidentaloma size and morning ACTH, and hip T score. Also, there was a weak but statistically significant correlation between incidentaloma size and systolic blood pressure (Table 2 and Figure 1). Correlation between diastolic pressure and tumour size was of borderline statistical significance (p=0.08).

Table 2. Correlation between incidentaloma size and other analyzed variables

	INCIDENTALOMA SIZE		
	N	r	p
Cortisol	172	0.30	0.00
ACTH	151	-0.21	0.01
Post-dexamethasone cortisol (log10)	197	0.57	0.00
Adrenaline	72	0.35	0.00
Noradrenaline	72	0.23	0.05
Aldosterone	30	-0.33	0.07
Systolic pressure	182	0.17	0.02
Diastolic pressure	182	0.13	0.08
Hip T score	42	-0.38	0.01
LS spine T score	42	-0.13	0.42

Figure 1.



Statistically, a significant correlation was also found between the incidentaloma size and 24 h urinary adrenaline, and noradrenaline.

Aldosterone was negatively correlated with the incidentaloma size, but statistical significance was borderline, and the number of patients was small (n= 30, r=-0.33, p=0.07)

Age, body weight, body height or BMI were not correlated with the incidentaloma size.

Incidentaloma size was not correlated with blood glucose concentration or with HbA1c level.

The best predictor for the cortisol non-suppressibility after 1 mg overnight dexamethasone (morning cortisol > 50 nmol/l was incidentaloma size equal or larger than 29 mm, and patients were divided into two groups: small (S) with the tumour size less than 29 mm and large (L) with the tumour size equal or larger than 29 mm. The odds ratio for the cortisol non-suppressibility after 1 mg overnight dexamethasone was 8.55 for L vs. S incidentalomas.

Subjects in the L group, also, had higher morning cortisol concentrations. Interestingly, L group had significantly larger cortisol response to ACTH stimulation (Table 1).

Discussion

We found that incidentaloma size is associated with the autonomous cortisol secretion. This manifests as an increase in morning cortisol and a decrease in morning ACTH related to an increase in tumour size, and reduced cortisol suppression by dexamethasone in larger incidentalomas.

Tumour size was also associated with the increase in 24 h urinary adrenaline and noradrenaline. In all patients, both adrenaline and noradrenaline were within local reference ranges, and none of the patients had symptoms or signs of pheochromocytoma, although some had hypertension. None of the adrenalectomized patients had pheochromocytoma. Based on the current knowledge, it can be hypothesized that changes in catecholamine and cortisol secretion are interrelated and due to cortical-chromaffin cell interactions in the adrenal gland [10–13].

Relation between aldosterone and incidentaloma size has borderline statistical significance (p=0.07, r=-0.33, N=30). However, these results are not reliable because of the small number of patients and the fact that some patients were on a drug therapy that could influence aldosterone levels.

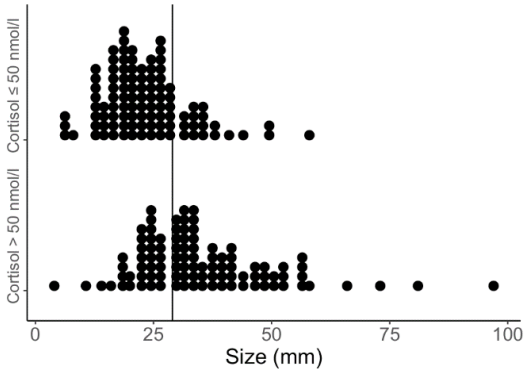
Glucocorticoids are associated with pleiotropic effects that include hypertension, obesity, reduction in bone mass and diabetes [14]. Association between adrenal incidentalomas and osteoporosis and vertebral fractures is well known [15]. A meta-analysis showed that prevalence of vertebral fractures among incidentaloma patients with autonomous cortisol secretion (ACS) is 63.6%, while in the patients without ACS

fracture prevalence is about 28% both significantly higher than in control subjects where prevalence was 16% [16]. We found a negative correlation between incidentaloma size and hip T score, but not with LS spine T score (hip r=-0.38, p=0.01, LS spine r=-0.13 p=0.42, N=42). Interestingly, neither hip T score nor LS T score was correlated with morning cortisol or morning ACTH. Post-dexamethasone cortisol concentration was correlated with the hip T score and marginally correlated with LS spine T score (hip r=-0.28, p=0.07, LS spine r=-0.04 p=0.80, N=42). Reason for lack of association between tumour size and LS T score is not clear now, but it can be due to non-systematic and biased choice of patients. Subjects in which osteodensitometry was done were older females (osteodensitometry vs no osteodensitometry age: 64.9, 95CI 62.4-67.4 vs 58.4 95CI 56.4-60.3, p=0.001, sex females 88.1% vs 69.7% p=0.017). As the subjects in which osteodensitometry was performed were older females and their osteoporosis may be associated with menopause.

It is well known that glucocorticoid excess is associated with hypertension [17]. In this study, a weak, but statistically significant correlation between incidentaloma size and systolic blood pressure was present (Table 2 and Figure 1). Correlation between diastolic pressure and incidentaloma size was of borderline statistical significance (r=0.13, p=0.08). Neither systolic nor diastolic pressure was correlated with either morning cortisol or ACTH. However, both were significantly correlated with post-dexamethasone cortisol concentration (systolic r=0.21, p<0.01, diastolic r=0.23, p<0.01). However, all hypertensive patients were treated so correlations between incidentaloma size and post-dexamethasone cortisol concentration and blood pressure were probably reduced and reflects the effects of antihypertensive treatment.

We found that optimal tumour size cut-off for dexamethasone suppression was 29 mm and divided our patients accordingly. The odds ratio for the cortisol non-suppressibility after 1 mg overnight dexamethasone was 8.55 for L vs. S incidentalomas (Figure 2).

Figure 2.



Subjects in L group had significantly higher morning cortisol, and increased cortisol response to Synacthen stimulation compared to S subjects. The increased cortisol response to ACTH was previously shown, especially in patients with adrenal incidentalomas and low basal ACTH [18]. The increased response to ACTH could be a mechanism in the development of adrenal autonomy and adrenal incidentaloma growth.

Prevalence of diabetes and insulin-treated diabetes was the same in the S and L group.

The major drawback of this study is a retrospective nature. This study reflects a clinical approach to patients in our institution. However, when clinical suspicion of autonomous cortisol secretion is higher more tests are done and that biases results of our study. Also, a test for pheochromocytoma only in patients with clinical suspicion for this disease. Finally, missing data in this study are not random but caused by diagnostic approach, therefore precluding the use of more advanced statistical methods (latent variable analysis e.g.). However, our data are consistent and in agreement with glucocorticoid effects and previous studies.

Another possible drawback is that imaging has been done in different hospitals or imaging centres and interpreted by a different radiologist. This could reduce the reliability of the study. However, this is a pragmatic study. In clinical practice, it is common that imaging is done in different hospitals and by different radiologist. Therefore, we do not think that this reduces the reliability of the study, as this approach reflects the real-life situation.

This is a pragmatic study. In clinical practice, it is common that imaging is done in different hospitals and by different radiologist. Therefore, we do not think that this reduces the reliability of the study.

We found that in adrenal incidentalomas subtle alteration in the secretion of catecholamines, aldosterone and cortisol are present. Howler, the clinical significance of all these changes is not clear.

Our study shows that the prevalence of adrenal autonomous cortisol secretion increases with incidentaloma size, and that prevalence of hypertension and osteoporosis also increases with an increase of incidentaloma size. In tumours equal to or greater than 29 mm prevalence of autonomous cortisol secretion ant its complications are increased, which suggest the need for a more aggressive approach for these tumours.

Declarations

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Consent to participate (include appropriate statements): Not applicable

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