Definitive diagnosis of mild hypercortisolism requiring treatment, without clinically evident Cushing’s syndrome, described as ‘pre-clinical Cushing’s’, represents a considerable challenge. The fact that the diagnosis of Cushing’s syndrome is often delayed by several years (1, 2) is not surprising, given that the early features are characteristically non-specific. However, detection in this pre-clinical phase offers the theoretical potential to prevent Cushing’s syndrome or reduce cortisol levels, which may otherwise act to accelerate cardiovascular disease (through blood pressure, lipids, and dysglycaemia) and ageing (through atrophic effects on skin, muscle and bone) and also have adverse neurocognitive effects.

Clinical Cushing’s syndrome is rare with an incidence of 3–10/million per year with the majority of cases arising from an adrenocorticotropin (ACTH)-secreting pituitary adenoma. In contrast, pituitary adenomas are very common with frequencies of 10% at autopsy and 10–38% by magnetic resonance imaging (3, 4).

Toini et al. (5) screened 68 patients with pituitary incidentalomas using the 1-mg overnight dexamethasone suppression test (DST) and a cortisol cut-off set at 50 nmol/l – 7/68 were abnormal with post-dexamethasone cortisol levels 64–505 nmol/l. One patient had low ACTH and excess adrenal cortisol. Of the remaining six patients, five did not exhibit normal suppression to a 2 mg 2-day low-dose DST (LDDST) and were classified as having ACTH-dependent hypercortisolism, with an additional requirement for either an elevated 24-h urinary free cortisol (UFC), present in three of the four tested in the 1.1- to 2.7-fold normal range, or elevated midnight plasma (n=1, twofold normal) or salivary (n=3, 1.1- to 1.7-fold normal) cortisol in all the four tested.

The five patients (three males and two females) classified as having ACTH-dependent hypercortisolism had a mean age of 55 years (R 37–82 years) and comorbidities such as headaches (n=2), ischaemic stroke (n=1), mood disorders (n=2) and hypertension – considered essential in origin (n=2). Two had macroadenomas (13, 44 mm) with visual field defects and three had microadenomas. All had second-line testing (CRH or DDAVP stimulation, high-dose DST) and inferior petrosal sinus sampling in one patient, where it was necessary to exclude ectopic ACTH excess. Only three of the five patients with hypercortisolism underwent surgery as, of the remaining two patients, one refused to undergo surgery and another was unfit for surgery, and all had ACTH-positive immunohistochemistry of their adenomas. In addition, all three operated patients had low morning cortisol levels for 2–6 months while on replacement dose short-acting glucocorticoids, although one of these, who had stalk compression-related hyperprolactinaemia preoperatively, was rendered panhypopituitary by surgery.

Overall, biochemical testing was indicative of mild hypercortisolism in the five patients, universally so in the case of the required LDDST. Surgical findings of ACTH immunoreactivity in all three operated cases and isolated secondary hypocortisolism in two of the three patients are consistent with a pituitary tumour-driven cause for the mild hypercortisolism.

There are, however, important caveats regarding the testing, such as the limited specificity (85–95%) of standard tests for hypercortisolism (1-mg overnight DST, 24-h UFC and late-night salivary cortisol (LNSC)) (6). The diagnostic accuracy of these tests is further challenged by their use in low pre-test probability cases who are older and have more comorbidities than the often used healthy controls in establishing test accuracy (7, 8, 9). ACTH-positive immunohistochemistry is seen in up to one-third of clinically non-functioning pituitary adenomas, leading to
the description of ‘silent corticotropinomas’ with reputed
effects on tumour growth (10, 11). Hence, the presence of
ACTH immunopositivity cannot be used to retrospectively
validate the biochemical testing in individuals or small
numbers of cases. Prolonged isolated hypocortisolism
postoperatively is a guide to the presence of tumour-
driven hypercortisolism and was evident in two of the
two operated cases. However, hypocortisolism has
been seen after resection of adrenal incidentalomas even
after completely normal testing for hypercortisolism,
suggesting that tumour-driven autonomous cortisol
secretion rather than hormone excess may be sufficient
to predispose to postoperative hypocortisolism (12).

Despite the limitations of available tools to diagnose
mild Cushing’s syndrome, it is likely that this study, a
systematic protocol directed at mild hypercortisolism in
pituitary incidentalomas, did uncover a rate of 4–7% of mild
hypercortisolism in patients with pituitary incidentaloma.

Of course, we cannot conclude that this testing
regimen detected Cushing’s syndrome, as experienced
clinicians did not find evidence of the syndrome on
clinical assessment, for example, four of the five patients
had a normal BMI. Crucially, among the patients with
mild hypercortisolism, these clinicians did not detect
evidence of Cushing’s syndrome progression over a mean
follow-up period of 30 months (SI). Hypercortisolism
with few or no clinical features of Cushing’s syndrome
or ‘subclinical Cushing’s’ is a state for which there is
no precise biochemical definition.

Current recommendations for screening for cortisol
excess in pituitary incidentalomas vary, with the 2011
Endocrine Society Guidelines suggesting screening for
hypercortisolism in patients where Cushing’s syndrome is
clinically suspected (13) and other guidelines suggesting
that testing for cortisol excess using 24-h UFC should be
restricted to those with macroadenomas when there is no
clinical evidence of Cushing’s syndrome (3). These
recommendations have been made in the absence of
large systematic studies of screening for hypercortisolism
in pituitary incidentaloma.

Screening for Cushing’s syndrome among patients
with obesity has highlighted the difficulties with false-
positive test results (14). Initial enthusiasm for screening
for Cushing’s syndrome among patients with type 2
diabetes following reports of rates as high as 9.4% have
been tempered by subsequent negative studies (15). At
present, screening for Cushing’s syndrome among
patients with metabolic abnormalities representative of a
single feature of Cushing’s syndrome is not justified.

The clinical diagnosis of Cushing’s syndrome should be
based on the presence of a number of features appearing
together in time, with evidence of progression over a period
of follow-up, followed by testing for hypercortisolism.
Manifestations of Cushing’s syndrome include weight gain
with central adiposity, neuropsychological disturbance,
metabolic syndrome-type features such as hypertension,
hyperglycaemia and dyslipidaemia, and the eventual
development of atrophic features such as skin thinning
with bruising and risk of infections, muscle wasting and
osteoporosis with vertebral and distal lower limb fractures.
As equivocal results are common in testing for hypercorti-
solism, near-normal cortisol values need to be considered
carefully in the clinical context and repeated and related to
other tests for hypercortisolism to avoid over-diagnosis (4).

This study of pituitary incidentalomas recalls the
experience with adenal incidentalomas, where abnormal-
ities of the hypothalamic–pituitary–adrenal (HPA) axis are
frequent, such as non-suppression of cortisol to dexametha-
sone, elevated UFC, low ACTH and low DHEAS levels, and
where various combinations of abnormalities have been
used to diagnose subclinical Cushing’s syndrome, with
frequencies of up to 9% of cases (16). The ongoing difficulty
is determining the level of cortisol elevation that is clinically
significant and would justify surgery, despite the association
between elevated cortisol levels and metabolic abnormal-
ities such as hypertension, dyslipidaemia and abdominal
obesity, and some data showing improvements in these
cardiovascular risk factors postoperatively (17).

Hypercortisolism, measured in the form of integrated
cortisol measures (urine or saliva), disturbed cortisol
circadian rhythm or resistance to dexamethasone suppres-
sion can follow a range of physiological perturbations,
including stressors such as infection, trauma or psychic
threat, starvation such as that seen in anorexia nervosa or
pregnancy due to placental CRH secretion. In addition,
hypercortisolism may be observed in pathological con-
tions unrelated to tumours affecting HPA axis function,
such as melancholic depression, alcohol excess, together
representing forms of ‘pseudocushing’s syndrome’,
following prenatal glucocorticoid excess and in ageing
and dementia, perhaps related to atrophy of the hippo-
campi, which have a negative regulatory influence on the
CRH neuron (18). Chronic stress may lead to adaptive
processes that elevate glucocorticoids in the adrenal cortex
and facilitate catecholamines form the sympathetic
nervous system to produce an altered homoeostasis or
allostasis, which may be adaptive, but have negative long-
term consequences on metabolic and neurobehavioural
systems known as allostatic load (19). Tests to exclude
pseudocushing’s syndrome have been proposed, such as the dexamethasone/CRH and desmopressin tests, but they have not been evaluated in all conditions associated with hypercortisolism and our capacity to rule out that pseudocushing’s syndrome is limited (20, 21).

Clinically, unexpected isolated hypocortisolism may occur in patients with pituitary incidentalomas being excised for structural reasons, presenting with hypotension and nausea. This may be due to unanticipated ACTH secretion, which may not elevate but only replace and suppress normal corticotroph function.

A fundamental question is whether we should recommend routine detailed HPA axis testing in patients with pituitary incidentaloma and no evidence of clinical Cushing’s syndrome?

Such an approach unequivocally has risks, namely potential over-diagnosis of hypercortisolism due to the known high false-positive rates of the principal Cushing’s syndrome screening tests (1-mg overnight DST, 24-h UFC and LNSC), requiring repeated testings using different methodologies. Further, the detection or suspicion of hypercortisolism may lead to surgery that may be potentially unnecessary and expose patients to unnecessary surgical risks, such as hypopituitarism in the longer term or one of the more immediate risks of surgery such as ‘CSF’ leak, haemorrhage and infection. Finally, the morbidity and mortality benefits of detection of subtle hypercortisolism may lead to surgery that may be potentially unnecessary and expose patients to unnecessary surgical risks, such as hypopituitarism in the longer term or one of the more immediate risks of surgery such as ‘CSF’ leak, haemorrhage and infection. Finally, the morbidity and mortality benefits of detection of subtle hypercortisolism from pituitary incidentaloma are unknown.

Hence, the study by Toini et al. (5) represents an important contribution to knowledge, but further studies to address the risks and benefits of detailed HPA axis testing for detection of hypercortisolism in pituitary incidentalomas are required before any change to current recommendations for the investigation of pituitary incidentalomas can be justified.

Given the travails of biochemical testing in hypercortisolism, we should perhaps recall the quote:

‘We need to learn to measure what we value, not value what we can easily measure’
Marcus Aurelius (AD121-180)

References


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