# Serial dexamethasone suppression tests in depressed patients treated only with electroconvulsive therapy

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## Summary

Several systematic studies have evaluated serial dexamethasone suppression tests (DST) in patients with major depression who were treated with antidepressant medications. DST changes were noted to parallel clinical improvement in most recovering patients. If serial DSTs are a valid state-related correlate of depressive pathophysiology, all types of effective antidepressant treatment should result in DST 'normalization'. However, no treatment modalities other than antidepressant medications have been studied serially with systematic assessments. To test whether serial DSTs reflect clinical progress in depressives treated solely with electroconvulsive therapy (ECT), we studied weekly DSTs and Hamilton Rating Scales for Depression (HRSD) in 22 drug-free depressed patients. We observed progressive DST 'normalization' in most patients and moderately high correlations between weekly DST and HRSD values throughout treatment. Most patients receiving ECT became DST suppressors. In most patients the DST appeared to reflect the severity of depressive pathophysiology, perhaps providing serial feedback to clinicians monitoring the progress of treatment with ECT.

## Introduction

A number of investigators have reported on the patterns of dexamethasone suppression test (DST)

results in depressed patients during treatment with antidepressant medications (Carroll 1972; De La Fuente and Rosenbaum 1980; Greden et al. 1980, 1983; Holsboer et al. 1982, 1983; Targum 1983; Gerken et al. 1985; Bowie and Beaini 1985; Baumgartner et al. 1986; Grunhaus et al. 1987). From these studies it appears that the normalization of a previously nonsuppressive DST parallels a successful course of antidepressant treatment. Initial reports suggested that similar patterns of normalization occurred during electroconvulsive

therapy (ECT) (Dysken et al 1979 Greden and Carroll 1979 Albala et al 1981 Papakostas et al 1981) However more recent publications have not demonstrated an association between DST normalization and outcome from ECT (Coryell 1986, Debanand et al 1987)

To further examine the effects of ECT on DST results we studied 22 severely depressed patients treated with ECT only with weekly DSTs and concurrent clinical ratings before during and immediately after ECT treatment We addressed the following questions (1) Do pretreatment nonsuppressive DSTs normalize over time as ECT is administered? (2) If so do serial DSTs have a state-relationship with clinical improvement? (3) Are absolute post-dexamethasone plasma cortisol values clinically meaningful in monitoring clinical progress of patients treated with ECT?

## Methods

Twenty-two depressed patients were hospitalized in the Clinical Studies Unit for Affective Disorders (CSU) or the Clinical Psychobiology Program in the Department of Psychiatry of the University of Michigan Medical Center between 1979 and 1984 Selected demographic and clinical features for each patient are summarized in Table 1

Each patient received our standard research diagnostic evaluation (1) a 10–14 day drug-free period of evaluation (2) two or three unstructured clinical interviews (including at least one evaluation by a senior staff psychiatrist) (3) a structured diagnostic interview by a trained interviewer using the Schedule for Affective Disorders and Schizophrenia (Spitzer and Endicott 1975), (4) physical

TABLE 1

DEMOGRAPHIC AND CLINICAL FEATURES OF INDIVIDUAL PATIENTS

| Case | Age (years) | Sex | Pre-ECT weight (kg) | Current episode of depression | | | Previous history of depression | | Menopausal status [a] |
|------|------|-----|------|------|------|------|------|------|------|
| | | | | Duration (months) | Pre-ECT drug [a] responsiveness | Duration (years) since onset | Number of previous episodes | Previous [a] responsiveness to ECT | |
| 1 | 70 | F | 64 5 | 2 | NR | 4 | 2 | R | PM |
| 2 | 51 | F | 68 9 | 9 | NR | 6 | 5 | – | PM |
| 3 | 47 | M | 79 3 | 18 | NR | 20 | 4 | R | – |
| 4 | 69 | F | 66 5 | 4 | NR | 3 | 4 | R | PM |
| 5 | 58 | F | 49 7 | 6 | NR | 2 | 2 | – | TAH |
| 6 | 66 | F | 46 0 | 36 | – | 12 | 13 | R | PM |
| 7 | 80 | F | 43 1 | 10 | – | 3 | 1 | – | PM |
| 8 | 58 | F | 62 0 | 24 | NR | 2 | 0 | – | PM |
| 9 | 34 | M | 85 8 | 12 | NR | 1 | 0 | NR | – |
| 10 | 28 | M | 74 8 | 5 | NR | 2 | 1 | – | – |
| 11 | 69 | M | 75 7 | 2 | – | 1 | 1 | – | – |
| 12 | 34 | F | 56 7 | 4 | – | 10 | 2 | R | A |
| 13 | 54 | F | 80 3 | 12 | NR | 26 | 5 | – | TAH |
| 14 | 68 | F | 53 5 | 6 | – | 6 | 0 | – | PM |
| 15 | 62 | M | 81 1 | 0 5 | – | 10 | 3 | R | – |
| 16 | 43 | M | 67 8 | 5 | NR | 24 | > 10 | R | – |
| 17 | 63 | F | 40 9 | 2 | NR | 3 | 4 | R | PM |
| 18 | 63 | F | 46 9 | 1 | – | 33 | 5 | R | PM |
| 19 | 64 | F | 76 2 | 1 | – | 0 8 | 0 | – | TAH |
| 20 | 59 | F | 46 3 | 4 | – | 23 | 4 | R | PM |
| 21 | 61 | F | 45 6 | 11 | NR | 25 | > 10 | – | PM |
| 22 | 66 | F | 65 5 | 6 | NR | 40 | 5 | R | PM |

[a] NR indicates nonresponsiveness R responsiveness PM postmenopausal TAH total abdominal hysterectomy A amenorrhea

examination and comprehensive laboratory screening to rule out serious medical illnesses (5) family interviews to validate longitudinal history and (6) reviews of previous medical records Following collection of information consensus diagnoses were compiled using Research Diagnostic Criteria (RDC) (Spitzer et al 1975 Carroll et al 1980) Diagnosticians always were blind to DST results

Inclusion criteria were (1) severe depressive symptoms treated exclusively with ECT (2) weekly DSTs prior to and during ECT treatment (3) no technical sources of variance that would invalidate any of the DSTs (Carroll et al 1981), including no serious medical illness no history of severe weight loss (greater than 20% below normal body weight) no alcoholism or drug abuse no pregnancy and no treatment with invalidating drugs including

carbamazepine (Privitera et al 1982) (4) weekly 17-item Hamilton Rating Scale for Depression (HRSD) completed by raters blind to DST results (Hamilton 1960) (5) no treatment with any psychoactive medication during the course of ECT (other than those necessary for the administration of ECT), and (6) informed consent to participate in research All patients who met these criteria were included in the sample

Twenty-one of 22 patients (Table 1) met RDC criteria for major depressive disorder (MDD) endogenous subtype Of these 17 (81%) had delusional symptoms Four unipolar patients (Nos 12 17 18 and 22) were nondelusional Patient No 9 received a diagnosis of schizoaffective (disorder) depressed Patient No 6 had a history of bipolar illness Seventy-one percent of the total sample were female The mean age (±SD) for the entire

TABLE 2

DST AND HRSD VALUES FOR INDIVIDUAL PATIENTS STANDARDIZED SERIAL TIME POINTS

| Case | Pre-ECT | | One-third | | Two thirds | | Post ECT | | ECT received (n) | Clinical response [1] |
|------|---------|---------|-----------|------|------------|------|----------|------|-----------------|-----------------|
| | HRSD [a] | DST [a] | HRSD | DST | HRSD | DST | HRSD | DST | | |
| 1 | 30 | 13 4 | 22 | 4 2 | 6 | 1 9 | 6 | 1 8 | 10 | R |
| 2 | 36 | 7 47 | 29 | 2 1 | 20 | 1 2 | 2 | 1 0 | 12 | R |
| 3 | 40 | 6 0 | 29 | 0 3 | 27 | 0 9 | 31 | 0 5 | 17 | NR |
| 4 | 32 | 13 4 | 32 | 23 8 | – | – | 7 | 2 2 | 6 | R |
| 5 | 30 | 9 9 | 26 | 10 7 | 2 | 5 3 | 1 | 0 9 | 8 | R |
| 6 | 18 | 7 99 | 10 | 0 9 | 2 | 3 0 | 3 | 1 7 | 8 | R |
| 7 | 21 | 16 4 | 2 | 5 6 | 2 | 11 8 | 1 | 2 2 | 6 | R |
| 8 | 42 | 6 0 | 29 | 9 2 | 16 | 2 7 | 13 | 1 4 | 12 | Partial |
| 9 | 18 | 4 0 | 6 | 0 6 | 6 | 0 4 | 4 | 1 1 | 6 | R |
| 10 | 34 | 5 3 | 22 | 7 8 | – | 1 1 | 21 | 1 3 | 18 | NR |
| 11 | 23 | 6 7 | 10 | 2 7 | 8 | 13 2 | 21 | 1 4 | 2 | Discontinued |
| 12 | 32 | 16 5 | 16 | 10 1 | 14 | 1 2 | 9 | 1 1 | 7 | R |
| 13 | 19 | 8 4 | 16 | 6 3 | 11 | 1 3 | 6 | 2 6 | 8 | R |
| 14 | 23 | 2 4 | 14 | 0 7 | 9 | 2 4 | 4 | 1 2 | 6 | R |
| 15 | – | 12 8 | – | – | 16 | 1 0 | 3 | 1 3 | 6 | R |
| 16 | 26 | 12 8 | 26 | 9 6 | 16 | 3 0 | – | 1 5 | 6 | Withdrew |
| 17 | 23 | 24 6 | 9 | 13 8 | 4 | 7 0 | 15 | 12 0 | 7 | NR |
| 18 | 25 | 8 7 | 9 | 5 9 | 21 | 11 5 | 12 | – | 18 | Partial |
| 19 | 19 | 13 4 | 21 | 11 1 | 15 | 12 8 | 4 | 12 0 | 9 | R |
| 20 | 35 | 12 9 | 32 | 12 9 | 14 | 2 0 | 3 | 1 3 | 9 | R |
| 21 | 19 | 9 9 | 21 | 5 0 | 17 | 13 2 | 7 | 3 1 | 14 | R |
| 22 | 37 | 24 2 | 29 | 18 0 | 20 | 13 0 | 12 | 5 1 | 10 | Partial |
| Mean | 27 7 | 9 3 | 18 4 | 7 7 | 12 3 | 5 2 | 5 8 | 2 7 | | |
| Standard deviation | 7 7 | 6 8 | 9 8 | 6 1 | 7 2 | 5 0 | 7 8 | 3 2 | | |

[a] HRSD indicates Hamilton Rating Scale for Depression scores DST maximum post-dexamethasone plasma cortisol values (μg dl) R responsiveness NR nonresponsiveness

group was 57 6 ± 13 0 years (range 28–80)

The mean weight for the total sample was 62 6 kg within ideal body weight ranges adjusted for age and height in this group of patients (assumed to be of medium frame) Mean pretreatment HRSD (17-item scale) score was 27 7 ± 7 7 (range 18–42) pretreatment HRSD scores for individual subjects are listed in Table 2

*Dexamethasone suppression tests*

A standardized DST approach was used for all subjects (Carroll et al 1981) We administered oral dexamethasone (1 mg) at 23 30 h each week and collected plasma samples for cortisol the following day at 16 00 and 23 00 h Samples were assayed for cortisol using a modification of Murphy's competitive protein-binding technique (CPB) (Murphy 1967) Our inter-assay and intra-assay coefficients of variation were 7 8% and 6 9% respectively

Patients were categorized as DST nonsuppressors if either their 16 00 or 23 00 h pretreatment DST value exceeded 5 µg dl Our reference value of 5 µg dl was previously determined by utilizing the CPB assay for cortisol in our clinical populations of depressed and nondepressed psychiatric patients as well as local normal controls Five patients received more than one drug-free DST before ECT was initiated

*Clinical ratings classification and outcome*

The 17-item HRSD coincided with weekly DSTs and both were always performed on days between ECT treatments

We operationally defined treatment response using HRSD scores Patients were considered good responders if they had at least a 50% reduction in HRSD score and a final HRSD value less than 10 partial responders if they had at least 50% reduction in the HRSD score but the final value was more than 10 and nonresponders if they had neither Response is tabulated in Table 2

To minimize problems associated with isolated interpretation of group data clinical and neuroendocrine outcomes were evaluated for both individual patients and for the group as a whole

The total number of ECT treatments was determined clinically To standardize the timing of serial assessments we analyzed HRSD and DST

outcome variables for the group at four time points (1) immediately prior to the first ECT treatment (2) upon completion of one-third of the clinically determined ECT course for each patient (3) upon completion of two-thirds of the ECT course and (4) within 1–3 days following the last ECT treatment

*Electroconvulsive treatment*

The clinical indications for ECT in these patients were combinations of severe depression the presence of delusional features previous poor response to medication or prior good response to ECT

Electrical impulses generated by a Medcraft instrument were administered bitemporally in all but one case (patient No 8 received unilateral treatments) Seizure activity was recorded in all cases with the use of a limb tourniquet and or simultaneous EEG recordings Standard anesthetic pretreatment included use of a short-acting barbiturate to induce sleep (average dose = 0 75 mg/kg) succinylcholine for muscle paralysis (average dose = 1 mg/kg) and glycopyrrolate (average dose = 0 3 mg 45 min prior to treatment) to reduce secretions

No antidepressant antipsychotic or sedative-hypnotic medications were administered for at least 10 days prior to ECT or at any point during the treatment course Thus conditions were not confounded by concomitant somatic treatments

The total number of electroconvulsive treatments administered to each patient is listed in Table 2 ECT treatments were administered independently from DST results The frequency is indicated by arrows on the horizontal axis for each patient in Fig 2 For patient No 11 treatments were discontinued after five ECT due to mental confusion Patient No 16 withdrew consent after receiving six ECT Final outcome variables for patients Nos 11 and 16 are excluded from all analyses of aggregate data

Serial ECT, DST data from one patient (No 2) appeared in an earlier report (Albala et al 1981)

*Data analysis*

All DST values were log-transformed to obtain normality of distribution and equality of variances before statistical analyses were performed To de-

termine the significance of decreases in DST values and HRSD scores over time during ECT treatment one-way ANOVA with repeated measures was used paired *t*-tests were used for parametric comparisons between pre- and posttreatment DST and HRSD results, respectively For dichotomous variables we used either the chi-squared test or Fisher's exact probability test Pearson's product–moment correlations were used to assess the relationship between DST values and HRSD scores for each individual patient during the course of ECT treatment

## Results

### Serial changes in mean post-dexamethasone values during ECT

Mean post-dexamethasone plasma cortisol values and HRSD scores at the four standardized serial time points during ECT treatment are shown in Fig 1

These aggregate data indicate that progressive normalization of the DST occurred during resolution of the depressive syndrome with treatment One-way ANOVA with repeated measures confirmed significant reductions in these scores over time ($P < 0.001$) Pairwise comparisons between pre- and post-ECT treatment values confirmed highly significant reductions ($P < 0.001$) in both DST and HRSD scores

### Changes in the percent of DST nonsuppressors over time

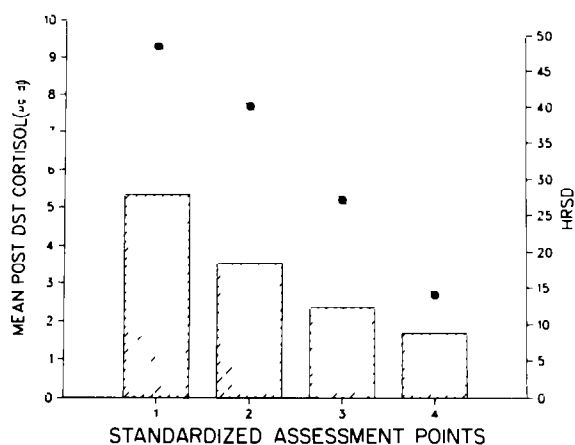Table 3 reveals that when data were analyzed categorically (suppressors vs nonsuppressors de-



Fig 1 Mean post-dexamethasone plasma cortisol concentrations in $\mu$g dl (solid circles) and Hamilton Rating Scale for Depression scores (vertical hatched bars) for total sample at four time points (1) immediately prior to ECT (2) after completion of one-third of the course of ECT (3) after completion of two-thirds of the course of ECT (4) 1–3 days after last ECT

pressed vs euthymic) there was a steady decrease in the percentage of both nonsuppressors and depressed patients during treatment Thus categorical analyses supported trends from mean data

### Comparison of responders vs nonresponders

Thirteen patients (Nos 1 2 4 5 6, 7, 9 12 13 14, 15, 20 21) had posttreatment DST suppression DSTs and good response Three patients (Nos 3,8,10) had posttreatment DST suppression but only partial or nonresponse Three patients had posttreatment DST nonsuppression, of these

TABLE 3

NUMBERS AND PERCENTAGES OF PATIENTS WHO ARE DST NONSUPPRESSORS AND DEPRESSED AT STANDARDIZED SERIAL TIME POINTS

| | Immediate pre-ECT | One-third ECT | Two-thirds ECT | Immediate post-ECT |
|---|---|---|---|---|
| DST nonsuppressive * (> $\mu$g dl) | | | | |
| *n* | 20/22 | 14/21 | 8 21 | 3 19 |
| % | 90 9 | 66 7 | 38 1 | 15 8 |
| Depressed ** (HRSD > 10) | | | | |
| *n* | 22/22 | 16 21 | 13 21 | 6, 20 |
| % | 100 | 76 2 | 61 9 | 30 |

* Chi-square = 26 74  *df* = 3  $P < 0.001$
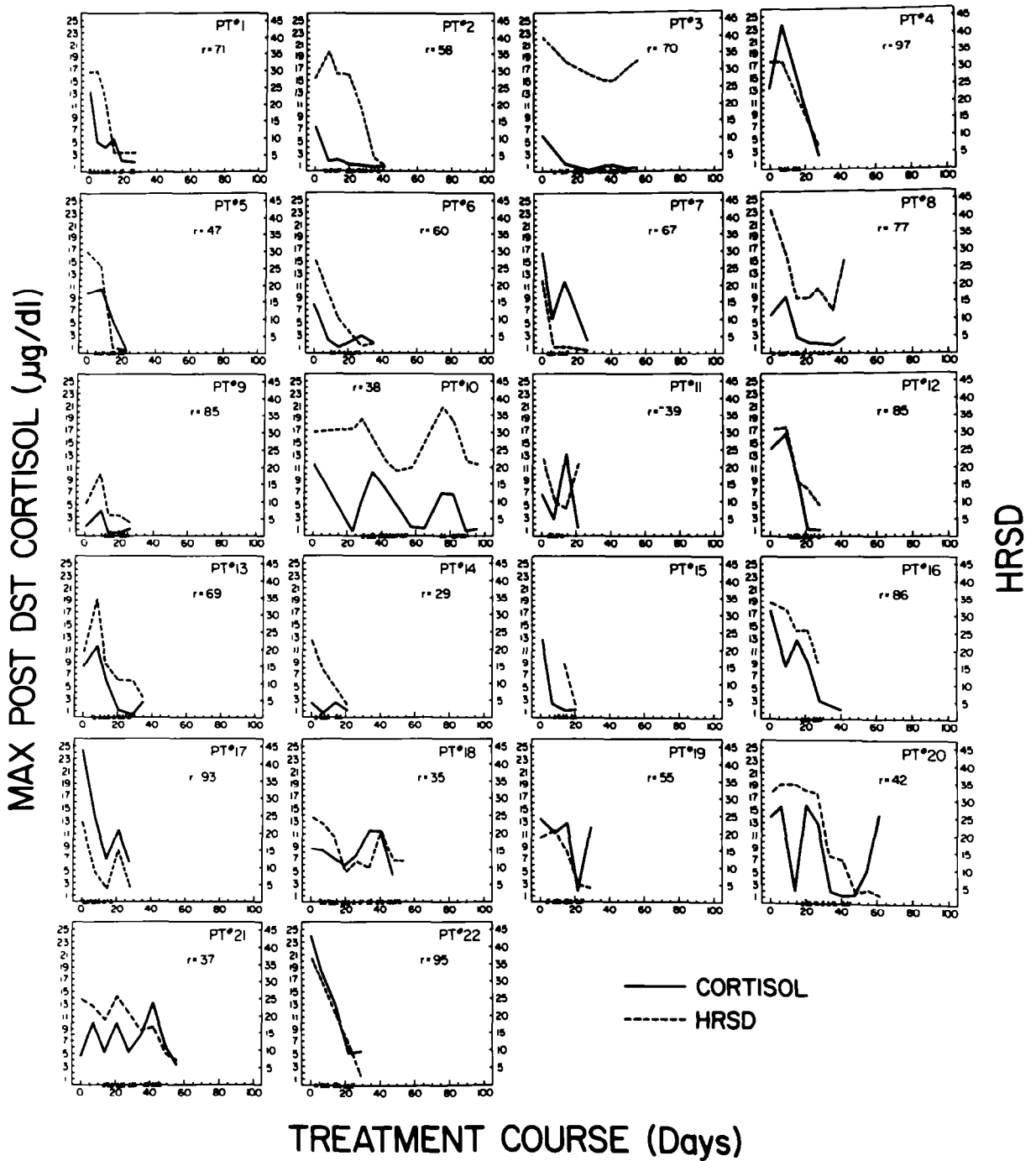** Chi-square = 24 57  *df* = 3  $P < 0.001$

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Fig 2 Serial post-dexamethasone plasma cortisol values (DST) and matching Hamilton Rating Scale for Depression (HRSD) scores for individual patients during ECT treatment Correlation coefficients (r) for each patient are shown Arrows indicate days of ECT treatments

two (Nos 17 22) had partial or nonresponse clinically while one (No 19) had good outcome Three patients were not considered in this analysis because their ECT treatments were discontinued (Nos 11 16 as explained previously) or they had missing data (No 18) In summary 13 of 16 patients (81%) with posttreatment DST suppression had a good outcome compared with one of three patients (33%) who had posttreatment DST nonsuppression and good outcome (Fisher's exact = 0 15 N S ) Stated differently among good ECT responders 13 of 14 (93%) were DST suppressors

*Individual patterns of serial DST and HRSD measurements during ECT treatment*

Gibbons and Davis (1984) have emphasized that analysis of mean values of repeated observations over time may lead to a significant loss of within-subject information To address this possibility, we plotted each patient separately and examined serial post-dexamethasone plasma cortisol values and matching HRSD scores (Fig 2) A rather strong temporal association between DST values and HRSD scores was evident in many patients

Individual plots of weekly DST values and HRSD scores for each patient revealed significant between-subject variation in patterns of association between these two variables (Fig 2) Inspection reveals that most patients had individual patterns of DST normalization and clinical improvement which roughly paralleled the aggregate pattern shown in Fig 1

Suggestive oscillating rhythms of post-dexamethasone plasma cortisol were noted in some patients (e g , Nos 10, 17 21)

*Weight as a confounding variable*

We studied weekly weights for each of the subjects in this study to determine the extent to which they influenced serial DST findings (Berger et al 1982, Edelstein et al 1983 Feinberg and Carroll 1984) The mean weight for the entire group changed from 62 6 kg before treatment to 61 5 kg 63 8 kg and 65 1 kg respectively at one-third, two-thirds and post-ECT treatment Thus mean weight continued to fall even after initial ECT treatments while mean DST values had begun to normalize (Figs 1 2) Thus aggregate data generally confirmed a lack of association between DST values and weight change during ECT treatment

**Discussion**

These data indicate that electroconvulsive therapy induces patterns of DST normalization comparable to those observed in patients treated with antidepressant medication This finding supports a collection of prior reports (De La Fuente and Rosenbaum 1980 Greden et al 1980 1983 Albala et al 1981 Holsboer et al 1982 1983 Targum 1983) that in a large proportion of patients the DST is a state-related marker of depressive pathophysiology It also suggests that normalization of the DST is not simply a confounded result stemming from administration of antidepressant medications over time

Our findings also illustrate that weekly HRSD scores and matching DST values are moderately to strongly correlated and that most patients receiving ECT become DST suppressors This project encountered a problem similar to that observed in most serial DST studies i e only a limited number of subjects fail to normalize when given effective treatment limiting the power of statistical analysis Thus considerations about failure to normalize of the DST and poor outcome continue to be tenuous

Clinicians could benefit greatly from independent objective markers' that would aid identification of patients most likely to respond to ECT (Haskett 1982 Haskett and Albala 1982) or in determining the optimal number of ECT treatments These DST data strengthen pilot reports that suggest that responders to ECT are more likely to become dexamethasone suppressors DST changes may provide biological confirmation of clinical progress in most patients but we caution against over-interpretation Normalization of the DST does not *always* predict good clinical outcome and persistent DST nonsuppression during ECT does not *always* preclude clinical improvement during treatment Some of the discrepancies found between studies might be clarified by longer periods of observation following recovery from depression It is well known that remission from a depressive episode does not follow a uniform pattern across patients It may well be that a similar

process occurs with the DST. Further refinements of research strategies are needed to address unanswered questions. For example, this study should be repeated with concomitant plasma dexamethasone levels to control for the possibility that repeated administration of barbiturates for ECT might change dexamethasone metabolism. If so, however, we would have expected to find progressively more nonsuppression, exactly opposite to what we observed. Finally, serial DSTs in untreated patients, i.e., those involved in placebo-controlled studies, may provide information on the 'naturalistic' course of hypothalamic-pituitary-adrenal axis dysfunction in depression.

## References

Albala, A.A., Greden, J.F., Tarika, J. and Carroll, B.J., Changes in serial dexamethasone suppression tests among unipolar depressives receiving electroconvulsive treatment, Biol. Psychiatry, 16 (1981) 551–560.

Baumgartner, A., Graff, K.J. and Kurten, I., Serial dexamethasone suppression tests in psychiatric illness, Psychiat. Res., 18 (1986) 25–43.

Berger, M., Doerr, P., Lund, R. et al., Neuroendocrinological and neurophysiological studies in major depressive disorders: are there biological markers for the endogenous subtype?, Biol. Psychiatry, 17 (1982) 1217–1242.

Bowie, P.C.S. and Beaini, A.Y., Normalization of the dexamethasone suppression test, Br. J. Psychiatry, 147 (1985) 30–35.

Carroll, B.J., The hypothalamic-pituitary-adrenal axis in depression. In: B.M. Davies, B.J. Carroll and R.M. Mowbray (Eds.), Depressive Illness: Some Research Studies, C.C. Thomas, Springfield, IL, 1972, pp. 23–201.

Carroll, B.J., Feinberg, M., Greden, J.F. et al., Diagnosis of endogenous depression, J. Affect. Disord., 2 (1980) 177–194.

Carroll, B.J., Feinberg, M., Greden, J.F. et al., A specific laboratory test for the diagnosis of melancholia, Arch. Gen. Psychiatry, 38 (1981) 15–22.

Coryell, W., Are serial dexamethasone suppression tests useful in electroconvulsive therapy?, J. Affect. Disord., 10 (1986) 59–66.

De La Fuente, J.R. and Rosenbaum, A.H., Neuroendocrine dysfunction and blood levels of tricyclic antidepressants, Am. J. Psychiatry, 137 (1980) 1260–1261.

Debanand, D.P., Decina, P., Sackeim, H.A., Hopkins, N., Novacenko, H. and Malitz, S., Serial DST's in initial suppressors and non-suppressors treated with electroconvulsive therapy, Biol. Psychiatry, 22 (1987) 463–472.

Dysken, M.W., Pandey, G.N., Chang, S.S. et al., Serial post-dexamethasone cortisol levels in a patient undergoing ECT, Am. J. Psychiatry, 136 (1979) 1328–1329.

Edelstein, C.K., Roy-Byrne, P., Fawzy, F.I. and Dornfeld, L., Effects of weight loss on the dexamethasone suppression test, Am. J. Psychiatry, 140 (1983) 338–341.

Feinberg, M. and Carroll, B.J., Biological 'markers' for endog-

enous depression — effect of age, severity of illness, weight loss, and polarity, Arch. Gen. Psychiatry, 41 (1984) 1080–1085.

Gerken, A., Maier, W. and Holsboer, F., Weekly monitoring of DST suppression response in depression, Psychoneuroendocrinology, 10 (1985) 261–271.

Gibbons, R.D. and Davis, J.M., The price of beer and the salaries of priests: analysis and display of longitudinal psychiatric data, Arch. Gen. Psychiatry, 41 (1984) 1183–1184.

Greden, J.F. and Carroll, B.J., The dexamethasone suppression test as a diagnostic aid in catatonia, Am. J. Psychiatry, 136 (1979) 1199.

Greden, J.F., Albala, A.A., Haskett, R.F. et al., Normalization of the dexamethasone suppression test: a laboratory index of recovery from endogenous depression, Biol. Psychiatry, 15 (1980) 449–458.

Greden, J.F., Gardner, R., King, D. et al., Dexamethasone suppression tests in antidepressant treatment of melancholia: the process of normalization and test-retest reproducibility, Arch. Gen. Psychiatry, 40 (1983) 493–500.

Grunhaus, L., Flegel, P., Pande, A., Kotun, J., Haskett, R.F. and Greden, J.F., DST nonsuppression predicts outcome in MDD, Paper presented at the Society for Biological Psychiatry Meeting, May, 1987.

Hamilton, M., A rating scale for depression, J. Neurol. Neurosurg. Psychiatry, 23 (1960) 56–62.

Haskett, R.F., Factors affecting outcome after successful electroconvulsive therapy, Psychopharmacol. Bull., 18 (1982) 75–78.

Haskett, R.F. and Albala, A.A., Relevance of neuroendocrine strategies in electroconvulsive therapy research, Psychopharmacol. Bull., 18 (1982) 57–62.

Holsboer, F., Liebl, R. and Hofschuster, E., Repeated dexamethasone suppression tests during depressive illness, J. Affect. Disord., 4 (1982) 93–101.

Holsboer, F., Steiger, A. and Maier, W., Four cases of reversion to abnormal dexamethasone suppression test response as an indicator of clinical relapse: a preliminary report, Biol. Psychiatry, 18 (1983) 911.

Murphy, B.E.P., Some studies of the protein-binding of steroids and their application to the routine micro- and ultra-micro-measurement of various steroids in body fluids by competitive protein-binding radioassay, J. Clin. Endocrinol. Metabol., 27 (1967) 973–990.

Papakostas, Y., Fink, M., Lee, J. et al., Neuroendocrine measures in psychiatric patients: course and outcome with ECT, Psychiatry Res., 4 (1981) 55–64.

Privitera, M.R., Greden, J.F., Gardner, R.W. et al., Interference by carbamazepine with the dexamethasone suppression test, Biol. Psychiatry, 17 (1982) 611–620.

Spitzer, R.L. and Endicott, J., Schedule for Affective Disorders and Schizophrenia, Biometrics Research Division, New York State Psychiatric Institute, New York, 1975.

Spitzer, R.L., Endicott, J. and Robins, E., Research Diagnostic Criteria for a Selected Group of Function Disorders, 3rd edn., Biometrics Research Division, New York State Psychiatric Institute, New York, 1977.

Targum, S.D., The application of serial neuroendocrine challenge studies in the management of depressive disorder, Biol. Psychiatry, 18 (1983) 3–19.