A Comparison of Contingency Management and Cognitive-Behavioral Approaches During Methadone Maintenance Treatment for Cocaine Dependence

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Background: This study compared 2 psychosocial approaches for the treatment of cocaine dependence: contingency management (CM) and cognitive-behavioral therapy (CBT).

Methods: Patients with cocaine dependence who were receiving methadone maintenance treatment (n=120) were randomly assigned to 1 of 4 conditions: CM, CBT, combined CM and CBT (CBT+CM), or treatment as usual (ie, methadone maintenance treatment program only [MMTP only]) (n=30 per cell). The CM procedures and CBT materials were comparable to those used in previously published research. The active study period was 16 weeks, requiring 3 clinic visits per week. Participants were evaluated during treatment and at 17, 26, and 52 weeks after admission.

Results: Urinalysis results during the 16-week treatment period show that participants assigned to the 2 groups featuring CM had significantly superior in-treatment urinalysis results, whereas urinalysis results from participants in the CBT group were not significantly different than those from the MMTP-only group. At week 17, self-reported days of cocaine use were significantly reduced from baseline levels for all 3 treatment groups but not for the MMTP-only group. At the 26-week and 52-week follow-up points, CBT participants showed substantial improvement, resulting in equivalent performance with the CM groups as indicated by both urinalysis and self-reported cocaine use data.

Conclusions: Study findings provide solid evidence of efficacy for CM and CBT. Although the effect of CM is significantly greater during treatment, CBT appears to produce comparable long-term outcomes. There was no evidence of an additive effect for the 2 treatments in the CM+CBT group.

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Cocaine dependence is an important public health problem in the United States. During the past decade, progress has been made in the area of psychological/behavioral treatments for individuals with cocaine dependence. The 2 approaches with the strongest empirical support are contingency management, based on the principles of operant conditioning, and cognitive-behavioral strategies, based on social learning principles.

Stitzer et al have documented the efficacy of establishing a contingent relationship between a desired response (frequently a urine sample free of drug metabolites) and the delivery of a positively reinforcing event (eg, money or some desired item) as a method for reducing illicit drug use. The delivery of a reward that is contingent on reduced drug use has become known as contingency management (CM). Higgins et al have demonstrated that the use of CM contributes to a significant reduction in cocaine use when used as part of a behavioral treatment package. These investigators also found that CM had sustained positive effects at 6 and 12 months after admission. Their work, and the work of Petry et al, has established CM as a powerful technique for reducing cocaine use.

Marlatt and Gordon introduced the concept that cognitive-behavioral strategies can be effective in treating substance use disorders. Carroll et al established...
the efficacy of a manualized protocol for treating cocaine dependence with cognitive-behavioral therapy (CBT). These studies demonstrated that use of their CBT manual reduced cocaine use over 1 year. In fact, their report suggests that CBT is more efficacious at follow-up points than during treatment. These and other studies have provided solid empirical support for the use of CBT in treating cocaine dependence.23-26

The approximately 180000 patients who are in methadone maintenance treatment programs (MMTPs) for opiate addiction are severely affected by the use of cocaine.21,22 Studies have documented the efficacy of CM and CBT in reducing cocaine use among these patients.23-26 However, little is know about the comparative efficacy of the 2 approaches.

The purpose of the present study is to compare the efficacy of CM and CBT, alone and in combination, for the treatment of cocaine dependence in patients receiving methadone maintenance and to explore whether reductions in cocaine use are sustained at posttreatment follow-up. The a priori hypotheses for this study were that all 3 treatment conditions would produce a reduction in cocaine use, whereas the MMTP-only condition would not, and that although CM may promote a more substantial reduction in cocaine use during treatment, CBT will produce a sustained reduction of cocaine use at follow-up points. Furthermore, it was predicted that the combined CM and CBT condition (CM+CBT) would produce better outcomes than either the CM or CBT conditions alone.

PARTICIPANTS AND METHODS

PARTICIPANTS

Candidates for this study were required to be in an MMTP for opiate use at 1 of 2 Los Angeles, Calif, clinics for a minimum of 90 days, to meet DSM-IV criteria for cocaine dependence, and to show evidence of cocaine use (at least 1 urine sample positive for cocaine metabolites) during the month prior to study enrollment. Individuals were ineligible if they were also dependent on alcohol or benzodiazepines to the point of requiring medical withdrawal or if their treatment was court mandated. The study clinics serve a disadvantaged population and employ a high-tolerance approach (ie, emphasis is on treatment retention, and no sanctions are applied for illicit drug use). The clinics charge patients $120 per month.

During the 2-year study recruitment period, approximately 1100 individuals were receiving methadone maintenance in the 2 clinics, and approximately 500 to 600 met eligibility criteria for study participation. Of those 300 to 600, however, only 180 volunteered for the study, and of this group, only 120 met study eligibility criteria, enrolled in the study, completed all baseline measures, and were randomly assigned to a study condition. This modest rate of study recruitment at- tends to the minimal interest these patients had in stopping cocaine use. In fact, a $40 per month methadone program fee reduction over the 16-week study period was necessary to promote study participation.

PROCEDURES

All research activities were reviewed and approved by the Institutional Review Board of Friends Research Institute, Los Angeles. Following informed consent procedures and baseline data collection, the 120 participants were randomly assigned to 1 of 4 study conditions: CM, CBT, CM+CBT, or treatment as usual (ie, MMTP only) (n=30 per cell). All interventions lasted 16 weeks. Participants in all conditions received identical methadone treatment services, as described below. The methods for this study were previously reported27 and are summarized here.

TREATMENT CONDITION DESCRIPTIONS

MMTP-Only Group

Individuals assigned to this treatment condition participated in the clinics’ standard methadone treatment. This treatment comprised daily clinic visits for methadone, twice-monthly counseling sessions, and medical care and case-management services as needed. The mean daily methadone dosage in the clinics during this period was 82 mg (range, 58-110 mg). The only characteristics that distinguished the MMTP-only patient group from the general clinic population were that the study participants were required to give 3 urine samples per week (compared with 1 per month for the general clinic population) and provide baseline, weekly, and follow-up data. In return, their clinic fees were reduced by $40 per month, and they received a $25 gift certificate at each follow-up interview.

Contingency Management Group

Participants in the CM group were required to provide 3 urine samples per week and meet briefly (2-5 minutes) with the CM technician while reviewing their methadone treatment. The meetings with the CM technician covered 4 topics: (1) a review of the results of the urine test (tested immediately using EMIT [enzyme-multiplied immunoassay technique]; Syva; Dade Behring, Deerfield, Ill); (2) the delivery of a voucher, if earned; (3) a discussion of how the voucher or accumulated voucher account could be redeemed; and (4) the delivery of the earned items when the vouchers were redeemed. On occasions when vouchers were earned, the CM technician provided praise and encouragement.

The voucher value was based upon an escalating schedule.4,10 The voucher value started at $2.50 per cocaine-negative urine sample and increased in value by $1.25 with each successive negative sample; patients received a $10 bonus for 3 consecutive cocaine-negative urine samples. The maximum voucher value was $20 per sample. When samples were missed or were positive for cocaine, the value of the voucher was reset to a lower level.4,10 The maximum possible earning (48 consecutive cocaine-free samples) was $1277.50. Participants were never given cash, and they were encouraged to “spend” their savings on items that supported drug-free activities.

Cognitive-Behavioral Therapy Group

The CBT procedure consisted of 48 group sessions (3 per week for 16 weeks) concurrent with participation in methadone treatment. The 90-minute groups had 4 to 8 participants, and each session was guided by a worksheet from a manual.28 Each worksheet presented a concept or a brief exercise that explained or illustrated an aspect of CBT. Each session was led by a master’s degree-level therapist in a standardized manner. Study counselors only delivered CBT and were not members of the methadone maintenance program counseling staff. All study counselors received 120 to 180 hours of didactic and experiential training in the CBT method prior to their study partici-
participation. All sessions were audiotaped and reviewed by a counseling supervisor on a weekly basis, and feedback was given to the therapist to ensure consistency with the protocol. Although there was no quantitative measure of therapist adherence, the session taping and supervision appeared to produce a standardized treatment experience.

Contingency Management and Cognitive-Behavioral Therapy Group

Individuals in this treatment condition participated in both the CM and CBT groups while they continued their methadone maintenance treatment. The CBT and CM procedures were delivered in parallel, and no attempt was made to integrate CM techniques with CBT.

Termination from the study could be a result of study completion, missing 2 consecutive weekly data collection visits, or missing either 6 consecutive CBT groups or 6 consecutive urine samples. Therefore, a consistent 2-week absence from protocol participation was the criterion for study termination across all study conditions. Study termination had no effect on methadone maintenance treatment.

STUDY MEASURES

Baseline data were collected with the Structured Clinical Interview for DSM-IV (SCID),29 the Beck Depression Inventory (BDI),30 and the Addiction Severity Index (ASI).31 All participants completed a BDI (to monitor safety) and provided a self-report of drug use weekly. All participants were required to give 3 monitored urine samples per week throughout the treatment intervention phase (16 weeks) and at 3 follow-up interviews 17, 26, and 52 weeks after study participation began. All samples were analyzed immediately for metabolites of cocaine (300 ng of benzoylecgonine was the cutoff), using EMIT reagent test procedures. In addition, 1 urine sample per participant per week and all follow-up urine samples were also analyzed for metabolites of illicit opiates, amphetamine, benzodiazepines, barbiturates, and cannabinoids. Although we were initially concerned about substitution of amphetamine for cocaine, only 8 of the weekly samples collected during the study were positive for amphetamine, suggesting that amphetamine was not substituted for cocaine among these patients. If participants missed or refused to give a urine sample, the sample was considered positive for the purposes of the CM intervention procedures.

Two trained PhD-level staff persons administered the SCID during the first 30 days of study participation. The SCID is a semistructured interview for making Axis I and II diagnoses, based on the DSM-IV. The SCID administrators were trained in a 1-week program based on the guidelines established by the developers of the SCID, and both passed proficiency tests.

DATA ANALYSES

An α level of .05 was used for all statistical tests presented in this article. The distribution of demographic and drug-use characteristics across the experimental interventions were evaluated using Pearson χ² and multivariate factorial analysis of variance (MANOVA) tests.

The differential effects on cocaine use were assessed using several measures. The primary outcome measure was based on the number of urine samples free of cocaine metabolite provided during the trial. Because study participants were tested for cocaine use thrice weekly throughout the 16-week intervention, the total number of cocaine-free samples could range from 0 to 48. Study participants were also tested weekly for opiates and several other drugs, making 16 the maximum possible number of urine samples negative for opiates. Inspection of the distribution of data revealed neither significant skewness nor extreme kurtosis for cocaine or opiate urinalysis measures. Thus, in-treatment drug-use measurements were analyzed using MANOVA techniques. To control for experiment-wise error rates that can result from multiple least-squares mean comparisons, Tukey-Kramer honestly significant difference statistical tests were used for all post hoc comparisons.

The second method for toxicological evaluation of urine samples employed a criterion of whether study participants achieved 3 consecutive weeks of cocaine abstinence during the active treatment intervention period. Percentages for each group achieving this criterion were compared using χ² tests.

To assess the results of toxicological examinations for cocaine following active treatment conditions, separate χ² analyses compared the percentages of participants who produced cocaine-negative urine samples at follow-up evaluations. Pairwise contrasts between groups were conducted with χ² tests using α levels determined by dividing the conventional α of .05 by the number of pairwise comparisons made.

Lastly, self-reported data from the ASI were also examined. Specifically, the mean numbers of days in which the participants reported using cocaine and opiates during the preceding month were contrasted between study groups. Similarly, other domains of functioning as measured by the ASI were compared using the previously mentioned procedures. Four retrospective 30-day reporting periods, occurring at baseline and at the 17-week, 26-week, and 52-week follow-up points, were analyzed via repeated-measures MANOVA and subsequent Tukey-Kramer tests.

RESULTS

PARTICIPANT CHARACTERISTICS

Slightly more than half of the participants (55%) were men. The mean age was 43.6 years. Whites accounted for 39% of the sample; African Americans, 32%; Hispanics, 26%; and other ethnicity, 3%. None of the between-group differences in participant characteristics presented in Table 1 were statistically significant, nor were there significant between-groups differences in the methadone dosage during treatment.

We evaluated 108 clients using the SCID Axes I and II diagnostic interviews (antisocial personality disorder module only). Table 2 displays the prevalence of substance use disorder, other SCID Axis I psychiatric disorders, and antisocial personality disorder by study condition. Only those diagnoses prevalent in more than 5% of the sample are shown. There were no differences between groups in the prevalence of psychiatric disorders. The frequency of antisocial personality disorder among participants is consistent with other reports on individuals receiving methadone maintenance.32

TREATMENT PARTICIPATION AND COMPLIANCE

Retention

The value of treatment retention as a dependent measure was severely compromised in this study by the necessity of a $40 monthly incentive to promote study en-
As illustrated in Figure 1, the percentage of participants achieving abstinence from cocaine for 3 consecutive weeks was significantly associated with treatment intervention (n=120; \( \chi^2 = 8.2; P = .02 \)). Figure 2 depicts the percentage of participants from each group who had urine samples free of cocaine metabolites for 3 consecutive weeks. Comparisons of the percentages of patients achieving 3-week abstinence revealed significant contrasts between interventions. Significant group differences were found between the CM (63%) and MMTP-only (27%) groups (n=60; \( \chi^2 = 8.2; P = .004 \)) and the CBT+CM (57%) and MMTP-only groups (n=60; \( \chi^2 = 5.6; P = .02 \)). The percentages of CBT (40%) and MMTP-only group participants achieving 3-week abstinence were not statistically significant (n=60; \( \chi^2 = 1.2; P = .27 \)).
We were also interested in whether the techniques used to reduce cocaine use had any influence on participants’ use of illicit opiates. The mean (SD) number of opiate-free urine samples across interventions was 5.7 (5.3) of 16 possible samples taken. There was no evidence that the groups differed in opiate use during the intervention period (n=120; F3=0.26; \(P = .86\)).

**COCAIN USE AT WEEK 17**

Study participants were asked to provide urine samples at each follow-up assessment. At the end of active treatment intervention (week 17), urinalysis results were similar to the in-treatment results (n=101; \(\chi^2 = 10.2; \ P = .01\)). The 2 treatment interventions that featured CM had the highest percentages of cocaine-free samples (CM group, 60%; CBT+ CM group, 47%), followed by the CBT intervention (40%), and, lastly, the MMTP-only group (23%). After controlling for inflated \(\alpha\) error associated with conducting 5 pairwise contrasts (\(\alpha = .05/5 = .01\)), the only significant pairwise contrast was between the CM and MMTP-only groups (n=50; \(\chi^2 = 9.7; \ P = .002\)).

**SELF-REPORTED COCAINE USE**

Although the urinalysis results offered the most reliable picture of in-treatment performance, a comparison of the self-reports of previous-month cocaine use taken from the ASI at baseline with those taken at the end of treatment (week 17) shows significant changes among study participants’ cocaine use (within-group paired \(t\) test; \(n=107\); \(t_{106} = 6.0; \ P < .001\)). The MANOVA results indicate a significant main effect for all 3 treatment groups with regard to the reduction in the mean number of days subjects reported using cocaine from the month preceding admission to the month preceding the end-of-treatment interviews (\(n=107\); \(F_3=3.9; \ P = .01\)). However, post hoc comparisons revealed that none of the observed differences between treatment groups were statistically significant. All participants within each treatment modality reported significantly fewer days of cocaine use than were reported at baseline. There was no significant reduction for the MMTP-only group.

**OTHER MEASURES OF IN-TREATMENT EFFECTS**

In addition to comparing the baseline with week-17 cocaine-use measurements, 7 ASI composite scores were compared for reductions. Results showed that the reductions in ASI composite scores, if any, were not sig-
significant. The absence of a significant reduction in the ASI drug composite score despite significant reductions in cocaine use indicates the extent to which other drug use included in the ASI drug composite score continued. Further, with this group of older, chronically addicted individuals, the cessation of cocaine use did not produce significant change in other domains of functioning.

WEEK 26 AND 52 FOLLOW-UP COMPARISONS

Urinalysis Results

Figure 6 shows the percentage of subjects in each intervention with cocaine-free urine samples at the 3 follow-up points. Because the number of individuals contacted at each of the follow-up points was similar across the 4 conditions, the percentages of cocaine-free urine samples were calculated using 30 as the denominator for each condition. An analysis of the results using the number of samples collected as the denominator produced comparable statistical findings (data not shown).

At the time of the 26-week follow-up, the percentage of CBT group participants with cocaine-free urine samples (53%) exceeded the percentages of those in the CM (47%), CM+CBT (37%), and MMTP-only (33%) groups. This result, although not statistically significant (n=94; \( \chi^2 = 2.7; P = .43 \)), marks an interesting shift that became more pronounced at the 52-week follow-up. As shown in Figure 6, 60% of those assigned to the CBT group had urine samples that tested negative for cocaine at this time, compared with 53% in the CM group, 40% in the CM+CBT group, and 27% in the MMTP-only group (n=96; \( \chi^2 = 8.3; P = .04 \)). Pearson \( \chi^2 \) pairwise comparisons of this omnibus effect, using an \( \alpha \) criterion of .01, revealed that the only statistically significant difference was between the CBT and MMTP-only interventions (n=46; \( \chi^2 = 7.0; P = .008 \)). The changes by groups over time are illustrated in Figure 7.

In summary, it appears that at the 26-week and 52-week follow-up points, the cocaine use of CBT group participants improved from their end-of-treatment (17-week) use, in that the percentage of cocaine-free urine samples matched or exceeded that of the 2 groups who had received the CM procedures. As illustrated in Figure 6, the CBT group was the only treatment group to exceed the performance of the MMTP-only group at the final follow-up.

Self-Reported Cocaine Use in the Previous 30 Days

The mean number of days of self-reported cocaine use (of the previous 30 days) by treatment group at baseline and week 52 as measured by the ASI is illustrated in Figure 8. The MANOVA of the self-report data suggests a pattern of cocaine use similar to that seen in the data from the urinalysis results. Tukey-Kramer post hoc tests revealed that subjects in both the CBT and CM groups self-reported significantly fewer days of cocaine use than the MMTP-only group at the time of the 26-week follow-up and only the CBT subjects self-reported significantly fewer days of cocaine use than the MMTP-only group at the time of the 52-week follow-up. Therefore, self-reported data provide additional support for the persistence of CBT intervention effects at the posttreatment periods seen in our analyses of urine data.

To explore the specificity of this effect, the urinalysis results for opiates were analyzed across the 3 follow-up points. There were no group differences at any follow-up point, which was consistent with the intervention analyses for opiates. Furthermore, there were no significant changes in ASI composite scores from baseline to any follow-up point.

The purpose of this study was to compare the effectiveness of 2 promising interventions for the treatment of co-
caine dependence, CM and CBT, alone and in combination in a randomized clinical trial. Because the selection of patients in opiate-dependence treatment with methadone allowed for a no-cocaine treatment condition, this study enabled comparison of these treatments with a control group.

The results of the study provide strong support for CM and CBT as treatments for cocaine dependence. Our data suggest that the impacts of the 2 interventions during treatment and at distant follow-up points are quite different. During the study and at the end of the 16-week study period, the CM procedure was associated with significantly more cocaine-free urine samples than was the control intervention. These urinalysis data were supported by self-reported data, although self-reported data suggested that CBT and CM, alone and in combination, produced significant reductions in cocaine use from baseline to week 17, whereas there was no reduction for the control group (MMTP-only group).

At the more distant follow-up points (weeks 26 and 52), the superiority of the CM procedure over the CBT procedure disappeared. By contrast, at both of these follow-up points an apparent improvement in the performance of the CBT group brought their cocaine use to a level comparable with that of the CM group. Although CM appeared to produce abstinence from cocaine that was sustained at follow-up, the performance of CBT group participants appeared to improve over time. This finding was supported by both the urinalysis data and the self-reported data collected in the ASI.

The mechanisms underlying the therapeutic benefit of the CM and CBT interventions may be quite different. It appears that positive reinforcement for cocaine-free urine samples (CM) produces an immediate and profound suppression of cocaine use. While CM treatment is in effect, this approach produces a greater reduction in cocaine use than does the CBT approach. When CM is applied for 16 weeks, this effect generally appears to be sustained for at least 1 year after admission.

The CBT approach did not produce as substantial a suppression of cocaine use during its implementation. However, individuals treated with this approach appeared to derive a benefit that became more pronounced during the follow-up period. Although this delayed effect was not systematically measured in this study, one possible explanation for it is that skills learned during treatment were successfully applied by the time of the follow-up interviews.

One consistent finding throughout the study was that the CBT + CM group did not demonstrate an additive effect. In fact, at week 17 and at the 26-week and 52-week follow-up interviews, both single-treatment groups had superior results compared with the combined group. The reason for the lack of an additive effect is not clear. It may be that delivering the 2 interventions in parallel is not useful. However, a combination of the procedures in some more carefully integrated manner might create a better synergy. Furthermore, it is interesting to speculate on the possible value of sequencing these treatments in such a manner that the immediate and pro-

found suppression of cocaine use resulting from CM might be followed by the enduring benefit provided by CBT.

One final point of interest is the lack of impact of all treatments on opiate use or ASI composite scores during and following the trial. These treatments did not produce a change in overall illicit drug use or related psychosocial performance domains indicative of broad-based lifestyle or personality alterations; rather, these techniques produced reductions in cocaine use only. As with addiction pharmacotherapies, it is possible for an efficacious psychosocial intervention to be extremely effective for one type of drug use but to not produce a generalized reduction in use of all harmful psychoactive substances.

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