Expressive arts therapy for hospitalized children: a pilot study measuring cortisol levels

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Abstract

This pilot study aimed at assessing the feasibility of capturing physiological evidence of reduced stress for hospitalized children following expressive arts therapy. Twenty-five patients were offered a novel form of expressive arts therapy, termed Healing Sock Creatures, during their stay in the hospital. Saliva samples were collected at two times in the afternoon for the purpose of measuring salivary cortisol levels. The patients were randomly assigned to two groups, a treatment group or a wait-list control group. A trend of decreased cortisol levels was apparent following therapy in the treatment group and concurrent steroid treatment, which is common in intensive care units, does not appear to interfere with the ability to measure decreased cortisol levels following therapy. Our results support the design of a formal study to assess physiological biomarkers of stress in hospital settings. To our knowledge, this is the first in-patient study assessing a biomarker of stress following expressive arts therapy for children.

Introduction

Expressive arts therapy is an approach that integrates psychotherapy with a multi-arts, intermodal approach using imagination, arts ritual, and the creative process. Through action orientation and verbalization, this practice can help children access, process, and integrate traumatic feelings in a manner that allows for appropriate resolution to reduce the stress of hospitalization.[1] One of the expressive arts therapy modalities offered in the pediatric programs at our hospital, termed Healing Sock Creatures©, has shown particularly compelling results for reducing stress based on comments by children, their families, and hospital staff. Healing Sock Creatures are crafted from unused, nonskid hospital socks, sewn and stuffed with *magic beans* and fiberfill; personalities are formed through a selection of button eyes and other embellishments. The use of the hospital socks makes the creation unique to the child's stay in the hospital and therefore imbues the experience with positive emotion. We designed this pilot study to assess whether it would be feasible to capture physiological evidence of stress reduction immediately following Healing Sock Creatures therapy in the hospital setting. Cortisol was chosen as the outcome measure because it is one of the major glucocorticoids produced in the adrenal cortex, and there is considerable precedent for its use as a physiological biomarker of stress.[2,3] Cortisol levels are often assessed in series throughout the day to determine a subject's diurnal cortisol rhythm, however a spot cortisol assay taken pre- and post-intervention provides a snapshot of the immediate stress-reduction effects of a given intervention.[4]

Materials and Methods

Our study was a randomized comparison between expressive arts therapy and no therapy for reducing salivary cortisol levels in hospitalized children. The trial was conducted at the pediatric in-patient ward and Pediatric Intensive Care Unit (PICU) of the California Pacific Medical Center from March 2012 to August 2012. The Internal Review Board at the California Pacific Medical Center approved the study protocol. All children ages 3-17 admitted to the two hospital wards were considered to be eligible for inclusion. Children were excluded if the hospital staff anticipated that the child would receive an invasive procedure during the 2-hour period planned for the experimental session. Consideration of this exclusion criterion largely determined the choice for the time of day for the experimental session (4:30-6:30 PM), in order to increase the chances of having two hours of uninterrupted time. Parents or legal guardians of children who met eligible criteria were asked to sign a written informed consent form; children ages 7 and up were asked to sign an assent form.

Participants were randomized into two groups, a treatment group or a wait-list control group. After collection of a saliva sample at 4:30 PM, participants who were assigned to the treatment group received a Healing Sock Creatures therapy session for 90 minutes. At 6:30 PM, a second saliva sample was collected. The 30-minute interval between completion of the therapy session and the second collection point was intended to allow sufficient time for reuptake of cortisol after the end of the therapy, based on a previous report.[5] Participants who were assigned to the wait-list control group provided saliva samples at the same times but did not receive any therapy or any special treatment other than standard care during the time between the two sample collections. Therapy was provided to these patients immediately following the second saliva sample collection. The therapy was provided to all of the participants by the same certified expressive arts psychotherapist. The methods were modified by the therapist according to each child's age. The small risk of skin puncture associated with the use of a needle for making the Healing Sock Creatures was minimized by the therapist performing the sewing for younger children and by constantly monitoring the older children. Similarly, constant monitoring and assistance by the therapist minimized the potential choking hazard posed by the use of buttons. The therapist kept a log for each therapy session that included a record of any external events that occurred during the therapy session that were outside of the experimental protocol, such as a wound dressing change, that might potentially influence stress (and cortisol) levels. The therapist later translated these records into an external events score while remaining blinded to any laboratory results. The score ranged from a value of -5 to 5 with -5 indicating the most impactful negative

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external events and 5 indicating the most positive external events.

Salivary cortisol rather than serum cortisol was chosen as the outcome measure due to its identification of bioavailable cortisol as opposed to total cortisol,[6] and to spare the children the discomfort of venipuncture. A Salimetric's Childrens Swab (Salimetrics Inc., State College, PA, USA) was used for the collection of saliva which is made from a polymer material that withstands chewing and is of sufficient length such that one end of the swab could be held while it was in the child's mouth, eliminating any choking hazard. After collection, tubes containing the swabs were labeled with random codes, put on ice, and transferred to a laboratory where the saliva was centrifuged out of the swabs and frozen at -70°C within 4 hours after collection. On the day of assay, a technician who was blinded to any patient identifying information or experimental group assignment thawed all of the samples and analyzed them for cortisol levels using a monoclonal antibodies-based assay, according to the manufacturer's instructions (Salimetrics Inc.). Values were determined by computing the average optical density (OD) for duplicate wells and subtracting the average OD for the nonspecific binding wells from the average OD of the zero, standards, controls, and unknowns. The percent bound (B/Bo) for each standard, control, and unknown was then calculated by dividing the average OD (B) by the average OD for the zero (Bo). A standard curve was calculated by interpolation using MATLAB (Mathworks, Natick, MA, USA) software and a four-parameter sigmoid curve fit. The derived parameters were then used to determine the concentration values of the controls and unknowns.

Results

Twenty-five potentially eligible patients were approached to enroll for the study upon admission to the hospital. All of these patients accepted the invitation and were included in the study, coming from diverse socio-economic backgrounds, ethnicities, and an array of medical diagnoses, including cancer, acute asthma, perforated appendicitis, encopresis, and scalp reconstruction subsequent to dog attack. Samples from two of the patients failed quality control tests during laboratory analysis and were excluded from further consideration. The mean age of the twenty-three (23) children included in the formal analyses was 8.5 years old (SD 2.6; range 4 to 16 years old) and thirteen patients (56.5%) were female. There were a total of 12 patients in the wait-list control group, 10 female and 2 male, ranging from 4 to 16 years old. One of these patients was admitted to the PICU (*versus* the pediatric in-patient ward) and 25% were receiving corticosteroid therapy on the day of the experiment. The mean external events score for this group was -1.75 (SD 2.42). A total of 11 subjects were in the treatment group, 8 males and 3 females (27.3%) ranging in age from 4 to 15 years old. Forty-five percent of these patients were admitted to the PICU and 36.4% were receiving corticosteroid therapy on the day of the experiment. The mean external events score for this group was -1.73 (SD 2.01). These demographic data are reported in Table 1.

Given the difficult and often traumatic environment of the pediatric in-patient ward and PICU, we were interested in the response of the clinical staff to the implementation of the study. We found the response of the staff to be overwhelmingly positive, with many nurses facilitating the process beyond what was asked of them. Comments from the staff also indicated that collection of saliva samples was not troublesome and that there was an apparent reduction of stress and improved sleep for patients as a result of the therapy sessions.

We next analyzed the cortisol level values from the initial (baseline) collection point for all of the patients. We found that most of the initial cortisol levels were relatively low (below 5 nmol/L), which is consistent with the known diurnal decrease in cortisol levels in the afternoon.[7] Pre-post differences were then calculated by subtracting the initial cortisol values from the final values. An apparent positive bias (0.50 nmol/L) in the pre-post cortisol differences for the control group warranted consideration prior to evaluation of differences for the treatment group, particularly as this contradicted the expectation that the continuing diurnal decrease in cortisol levels in the afternoon would be reflected as a negative difference even without any therapeutic intervention.[6] We therefore evaluated the potential influence of unavoidable events extraneous to the study protocol that were likely to influence stress and, consequently, cortisol levels. Using the external events score determined by the therapist we examined the distribution of control data as a function of this score by regression analysis and found that there was a linear trend, though not statistically significant (P=0.47). The amount of change contributed by the external events score was predicted to be -0.22 nmol/L for every unit of the external events score. For example, if there was an external events score of -5, the predicted contribution due to this influence would be a positive change of 1.1 nmol/L. This analysis indicates that any stress-reducing influence of the experimental intervention in the treatment group would need to potentially overcome contributions from negative external events in order to be observable.

Despite similar external events score averages for both groups, the average pre-post cortisol difference for the treatment group was negative (-0.95 nmol/L). While not significantly different than the control group by a Students' t-test (P=0.29), the negative average of the data is consistent with the notion of cortisol levels being decreased at the time of the second sample collection, after experiencing therapy. Outcomes of for all participants are presented in Table 2.

Table 1. Demographic description of wait-list control and therapy groups.

	Patient characteristics by group					
	Ctrl (n=12)		HSC (n=11)		Total (n=23)	
	Mean	SD	Mean	SD	Mean	SD
Age	8.29	3.79	8.64	4.20	8.46	3.91
Female	83.3%	10	27.3%	3	56.5%	13
Steroids	25.0%	3	36.4%	4	30.4%	7
PICU	8.3%	1	45.5%	5	26.1%	6
EE	-1.75	2.42	-1.73	2.01	-1.74	2.18

Ctrl, wait-list control; HSC, healing sock creatures; SD, standard deviation; PICU, pediatric intensive care unit; EE, external events score.

Table 2. Outcome measurements.

	Cortisol measurements (nmol/L) by group						
	Ctrl (n=12)		HSC (n=11)		Total (n=23)		P*
	Mean	SE	Mean	SE	Mean	SE	
Initial	4.77	0.61	6.89	1.72	5.79	0.89	-
Final	5.27	0.75	5.94	0.93	5.59	0.58	-
Difference	0.50	0.67	-0.95	1.19	-0.20	0.67	0.29

Ctrl, wait-list control; HSC, healing sock creatures.
*The P-value is from a paired, two-tailed t-test between the Ctrl and HSC groups' cortisol differences.

Between-groups analyses of covariance (ANCOVAs) were also conducted with cortisol difference as the dependent variable and the initial value, as well as each of the reported patient characteristics as the independent variables. Statistical significance was found for initial values ($P<0.05$) and for corticosteroid therapy ($P<0.01$). Given that most of the initial values were relatively low, it is not surprising to find such a dependency of the measured differences to the initial readings. Indeed, large increases that were noted for some of the patients in the control group might be attributed to the initial cortisol levels being at their diurnal low point and therefore only susceptible to non-specific increases (*e.g.*, due to extraneous external events). Interestingly, there was statistical significance on the interaction term for treatment ($P<0.05$) in the case of corticosteroid therapy.

Discussion and Conclusions

Results reported in our pilot study support the design of formal studies to assess physiological biomarkers of stress for hospitalized children. Despite the generally stressful environments of the pediatric in-patient ward and the PICU, and the fact that many of the patients were on corticosteroid therapy, a measurable trend of decreased salivary cortisol was observed following a 90-minute expressive arts therapy session. While this provocative trend was not statistically significant, further research evaluating physiological mechanisms underlying the stress-relieving influence of Healing Sock Creatures therapy and other expressive arts modalities seems justified. The spot cortisol assays taken pre- and post-intervention in this study were planned for the afternoon to increase the chances of having uninterrupted time for the experimental sessions, however the relatively low initial cortisol levels measured at that time of day limited our ability to observe subsequent decreases following therapy. Thus, coordinating with hospital staff to accommodate earlier experimental sessions for future studies will likely reveal more robust differences in cortisol levels associated with therapeutic interventions.

Another experimental design question we considered at the outset of this study was whether or not to exclude patients receiving corticosteroid therapy. This question was raised because of the concern that corticosteroid therapy might lock cortisol levels and thereby mask any potential influence of expressive arts therapy. Ultimately, the inclination to exclude these patients was countered by a greater concern that recruitment would be too difficult due to the large proportion of patients typically receiving corticosteroid therapy in these hospital units. Analysis of the data from this subgroup of patients suggests that the influence of expressive arts therapy was not masked by concurrent corticosteroid therapy. To the contrary, significant measured effects were observed in the corticosteroid therapy subgroup, potentially due to their having higher initial levels of cortisol (above 5 nmol/L).

A statistical power calculation on the means from the control and therapy groups (difference of -1.45 nmol/L) and pooled standard deviations yielded a relatively large estimated sample size ($n=54$) for attaining a significance level of $P=0.05$ with 90% power for a Student's t-test assuming the same underlying statistics. However, given the dependency on initial cortisol values, we were interested to see what effect on statistical power there might be when considering only samples from patients whose initial cortisol values were greater than a certain cutoff. This allows a prediction of how the sample size might be reduced in future studies that incorporate experimental sessions earlier in the day and thus start with higher initial cortisol values. Using a cutoff of 5 nmol/L increased the mean difference between the groups from -1.45 nmol/L to -5.97 nmol/L and yielded a much reduced estimated sample size ($n=10$), making formal studies much more feasible. Such future studies evaluating cortisol and other biomarkers have the potential to bring an entirely new physiologically-based perspective to the value of expressive arts therapies.

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