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Preliminary communication

Light exposure and depression in hospitalized adult patients with cystic fibrosis

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ABSTRACT

Background: Depression is common in CF. Light therapy is used to treat depression, but exposure in hospitalized CF patients has not been studied. To determine the potential for improvement in depressive symptoms in CF patients, we measured light exposure in hospitalized CF patients.
Methods: Light exposure was measured during hospitalization for 30 adult CF patients over 1 week. Depressive symptoms and quality of life were assessed simultaneously using the Center for Epidemiologic Studies Depression Scale (CES-D > 16 positive for depression) and the CFQ-R.
Results: 50% of patients were depressed, with a significant increase in length of stay between depressed and non-depressed patients (15.4 vs. 11.7 days, $p=0.032$). Only 23% of patients had >60 min of light exposure >1000 lx during 1 week, with average light exposure of 62 lx. There was no difference in light exposure between a new hospital room customized for natural light exposure and traditional rooms. Vitamin D was non-significantly decreased in depressed CF patients (25.1 vs. 32.6 ng/ml, $p=0.052$).
Limitations: The study was not blinded, which may affect patient light preferences. The cohort size was limited to a single center. Inclusion bias may be present as patients could refuse enrollment based on the nature of the study.
Conclusions: Hospitalized CF adults have a high incidence of depressive symptoms associated with longer hospitalizations. Hospital settings are associated with low light exposure and phototherapy may be an option for rapid treatment of depression in hospitalized CF patients.

1. Introduction

Cystic fibrosis (CF) is a chronic progressive disease characterized by recurrent respiratory infections and multiple body system involvement. Due to advances in therapeutics and earlier detection and institution of preventative treatments, survival now averages 37 years Cystic Fibrosis Foundation Patient Registry (2011). With increased lifespan, attention has been focused on improving quality of life and monitoring for symptoms of mood disturbances associated with a chronic, progressive disease. Depression rates in CF vary from 3% to 46% of children and adults (Burker et al., 2004; Riekert et al., 2007; Modi et al., 2010; Goldbeck et al., 2010; Smith et al., 2010), with the most recent CF registry data reporting 22% of adults having depression (2011). However, national registries are biased by inclusion of non-validated diagnoses, so the actual prevalence may be misrepresented. Depression in CF correlates inversely with lung function and is associated with worse health related quality of life (Riekert et al., 2007). Because inpatient hospitalizations account for nearly 47% of the total yearly costs for CF patients (Lieu et al., 1999) and depressed CF patients appear to have longer inpatient lengths of stay (Kopp et al., 2012), improving depressive symptoms in CF may shorten hospital stays and reduce disease burden.

Depression is difficult to acutely improve by pharmacologic methods, but some alternative therapies such as sunlight and light therapy have efficacy. Natural sunlight has been used to treat outpatient depression (Benedetti et al., 2001), and was shown to decrease hospital lengths of stay for depressed patients by 2.6 days in one study (Beauchemin and Hays, 1996). In addition to natural sunlight, intense phototherapy acutely improves depressed symptoms in hospitalized patients (Beauchemin and Hays, 1997), and is beneficial in day hospital programs (Lande et al., 2011). Besides effects on symptoms and length of stay, bright light treatment can

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also be an effective alternative therapy in groups at risk for side effects from anti-depressants, such as pregnant women (Wirz-Justice et al., 2011). Sunlight and light therapy have not been studied in CF to our knowledge, and could offer a potentially inexpensive treatment for hospitalized patients with co-morbid depression.

1.1. Aims of the study

To determine the potential for improvement in depressive symptoms in CF patients, we measured naturally occurring light exposure in hospitalized CF patients. We hypothesized that these subjects would have low light exposures, a high rate of positive depression screens, and poor quality of life while hospitalized.

2. Methods

2.1. Subjects

CF inpatients over the age of 18 years with 2 known CF causing mutations were recruited for this study. Clinical demographics were recorded upon enrollment. The only exclusion criteria were a history of prior suicide attempts or current suicidal ideation due to the sensitive nature of questionnaires. All subjects were consented with approval of the Institutional Review Board at Nationwide Children's Hospital. Subjects were enrolled during all 4 seasons of the year.

2.2. Light measurement

An Actiwatch 2 memory watch with external ambient light sensor and event marker (Philip's Respironics, Pittsburgh, PA) was used to measure light absorbance in lux during hospital stays for adult CF patients. All watches were sterilized between subjects. Light was measured continuously as lux over 1 week duration which allowed for variation in daily light exposure and accounted for a typical minimum length of admission. Light epochs were recorded in 30 s intervals for data transfer. Illuminance range of the watches was 5–100,000 lx. Subjects left the watch on at all times except to shower. Baseline in room light intensity was 300 lx in a patient bed, 1500–2000 lx by a window, and greater than 45,000 lx standing outside in sunlight on an overcast day (Sekonic Model 246 Handy Lum, Tokyo, Japan).

2.3. Depression screening

The Center for Epidemiologic Studies Depression Scale (CES-D) was administered upon admission and at discharge from the hospital and scored by study investigators. Reported scoring ranges included: >21 was possibility of major depression, 15–21 was mild to moderate depression, <15 was no overt depression. The CES-D is a well validated depression screening tool for all populations and has been used in CF research literature to assess somatic and cognitive changes of depression without underestimating signs of depression in a systemic disease like CF (Besier et al., 2011).

2.4. Quality of life scoring

The CF questionnaire revised (CFQ-R) was administered simultaneously with the CES-D at admission and discharge as a measure of health related quality of life (HRQOL). This is a well validated measure in the CF population for research studies (Riekert et al., 2007). CFQ-R scoring changes between admission and discharge date were compared for differences.

2.5. Statistical analysis

All analyses were performed with GraphPad Prism 6.0 (La Jolla, California). Paired *t*-tests were used for CFQ-R analysis. Mann–Whitney was used for LOS, depression, vitamin D, and lux scoring. Data is reported with mean $\pm$ standard deviation. A two-sided *P*-value <0.05 was considered statistically significant.

3. Results

3.1. Demographics

The demographics of the enrolled patients are summarized in supplementary Table 1 (S1). Thirty hospitalized adult CF patients were enrolled (mean age 26.1 ± 7.0 years). There were 63% males. The mean forced expiratory volume in one second (FEV_1) % predicted of the enrolled subjects was 48.2 ± 20.8. The mean length of stay for all patients was 13.3 ± 4.4 days. The mean baseline vitamin D, 25-hydroxy level was 27.8 ± 10.3 ng/ml.

3.2. Depression screening

Fifty percent of the patients screened positive for depression (mean overall CES-D 19.3 ± 13.8, mean CES-D of depressed patients 29.8 ± 10.1) with 17% scoring between 15 and 21 (mild-moderate depression), and 33% scoring >21 (major depression). There was a significant increase in length of stay between depressed CF patients and non-depressed patients (15.4 vs. 11.7 days, $p=0.032$, Fig. 1). There was no difference in length of stay for patients with a mild-moderate CES-D between 15 and 21 and a severe score greater than 21 (15.8 vs. 14.6 days, $p=0.98$). There was a non-significant trend for vitamin D levels to be lower in depressed compared to non-depressed patients (25.1 ± 6.9 vs. 32.6 ± 11.1 ng/ml, $p=0.052$, Fig. 1). There was no difference in FEV_1 between depressed and non-depressed patients (49.6 ± 19.79 vs. 46.79 ± 2.45% predicted, $p=0.58$).

3.3. Quality of life scoring

The CFQ-R has been previously validated in large studies of CF patients as well as demonstrating robust psychometric properties across visit domains (Quittner et al., 2012; Sawicki et al., 2011). All CFQ-R scores positively increased at discharge except role (-8.9, $p=0.044$) and treatment burden (-3.5, $p=0.38$). The domains of physical functioning ($+12.5$, $p=0.0015$), vitality ($+12.4$, $p=0.0046$), health perceptions ($+14.5$, $p=0.0009$), weight ($+27.0$, $p=0.0033$), and respiratory symptoms ($+23.4$, $p<0.0001$) significantly increased upon discharge for all patients. The domains of body image ($+10.6$, $p=0.053$), emotional disturbances ($+4.7$, $p=0.89$), eating disturbances ($+2.8$, $p=0.48$), social functioning ($+1.2$, $p=0.57$), and digestive symptoms ($+3.0$, $p=0.25$) had non-significant increases in scoring at discharge (Table 1). There was no difference in CFQ-R scoring between depressed and non-depressed patients (data not shown).

3.4. Light exposure

Only 23% of patients had more than 60 min of cumulative bright light exposure (>1000 lx) over 1 week. No patient had more than 60 cumulative minutes of light exposure greater than 10,000 lx, which is the equivalent time frame of a single therapeutic bright light session. No patient had more than 60 min of cumulative light exposure greater than 2500 lx, which would equal a single therapeutic bright light exposure if applied for 4 h continuously. The average awake light exposure for all patients